MACHINERY

Design—Construction—Operation

Volume 46 MARCH, 1940 Number 7

Machines of revolutionary design from the viewpoint of tool engineering have been installed during recent months in some of the prominent automobile plants. April MACHINERY —the Annual Automotive Number—will tell about them. It will place on record the first description of operations in the newest plant of the automotive industry, established to manufacture the greatest innovation introduced in 1940 cars. Other articles will deal with new washing methods that insure cleanliness on the inside, as well as on the outside, of castings; ingenious special machines installed in new connecting-rod lines; the world's largest tool and die shop; and unusual tool set-ups, covering a wide variety of automotive parts.

Product Index 235-252

Advertisers Index 255-256

PRINCIPAL ARTICLES IN THIS NUMBER

FOR COMPLETE CLASSIFIED CONTENTS, SEE PAGE 166

Latest Practice in Forging Shells.....*By Charles O. Herb* 89
Cutting Oils and Their Application.....*By Tracy B. Langdon* 93
Drawing and Forming Deep Tapered Shells..*By M. J. Goldstein* 95
Manufacturing Preparedness at Watertown Arsenal
By Colonel Rolland W. Case 99
Gear Materials and Their Heat-Treatment
By Edward J. Wellauer 103
Editorial Comment 108
There is an Important Job for the Smaller Industrial Plants—It Sounds so Easy: Industry Ought to Provide More Jobs—The Technical Writer at His Best Uses Few and Simple Words
American Machines in England's Busy Shops 116
Pluramelt—a New Steel Making Process..... 123
Reducing the Cost of Polishing.....*By Henry R. Power* 125
Cast Frame Versus Welded Construction in Press Design—A Comment.....*By A. E. Gibson* 130
Modern Industrial Plant Lighting 132
Change-Gears for Helical-Gear Hobbing....*By Russell H. Stout* 134
New Air-Hardening Tool and Die Steel..... 136

DEPARTMENTS

Engineering News Flashes 106
Ingenious Mechanical Movements..... 109
Design of Tools and Fixtures..... 111
Questions and Answers 115
Materials of Industry..... 138
New Trade Literature 140
Shop Equipment News..... 143
News of the Industry..... 155

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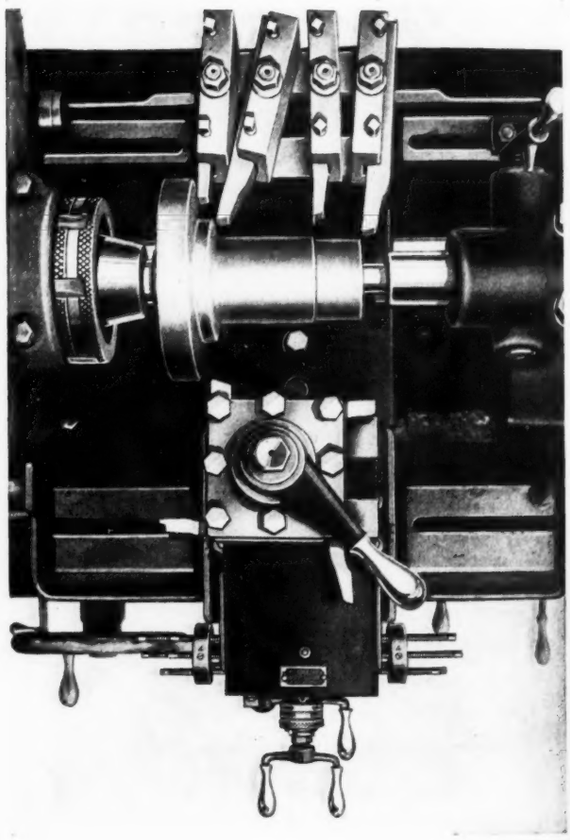

The operations on this gear blank require additional tooling and the four Swivel Tool Holders have been substituted for the High Duty Tool Block in order to perform the facing and necking operations.

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MACHINERY

Volume 46 NEW YORK, MARCH, 1939 Number 7

Latest Practice in Forging Shells

ADVANCES in forging practice during recent years have made it possible to forge projectile shells to such a degree of accuracy that it is no longer necessary to machine their internal surfaces. The machine illustrated in this article was recently built by the Acme Machinery Co., Cleveland, Ohio, for forging 75- and 105-millimeter shells. Specified tolerances on the shell bores—generally minus nothing, plus 0.020 inch—are maintained easily. The tolerances on the outside of the shell forgings are not so close, since the external surfaces must be machined all over.

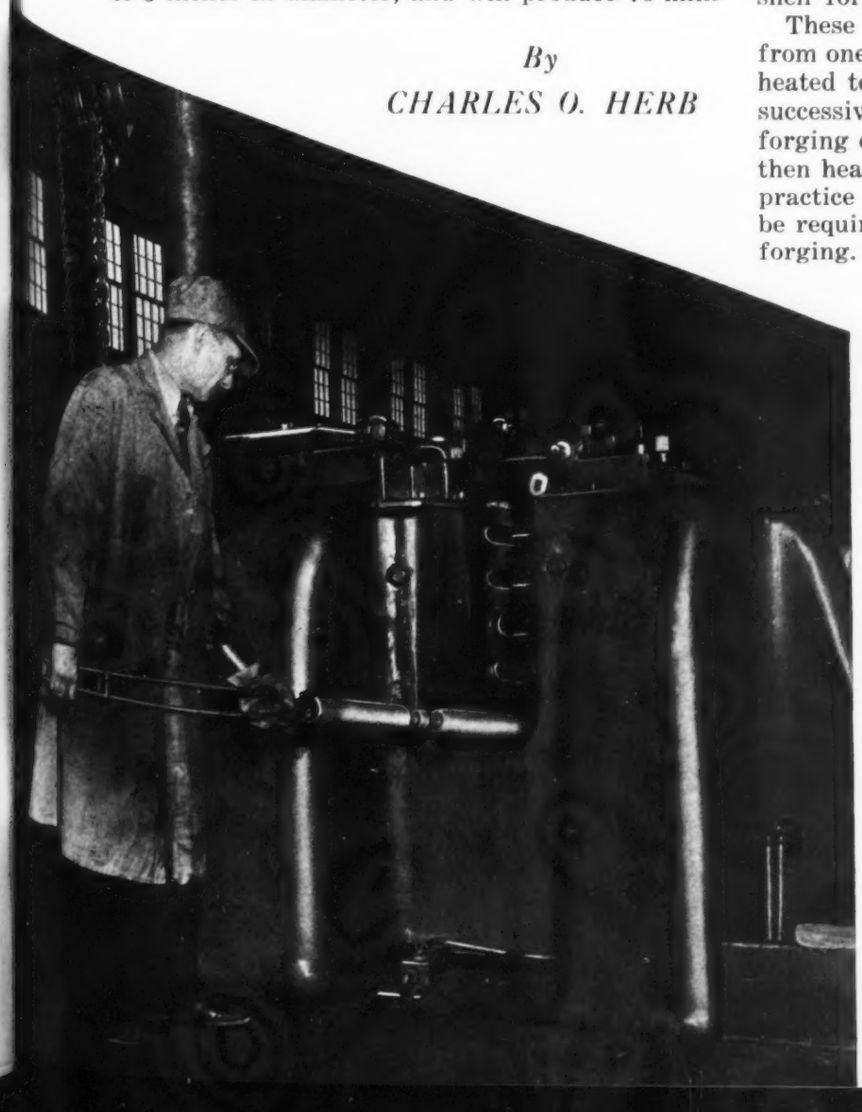
The machine is designed to handle bar stock up to 5 inches in diameter, and will produce 75-millimeter shells at an estimated rate of 75 shells an hour. The machine has a weight of 190,000 pounds, the frame alone being a one-piece steel casting that weighs over 100,000 pounds.

By

CHARLES O. HERB

Five-cavity dies are employed in this shell forging machine, as will be seen from Figs. 2 and 3. Fig. 2 shows diagrammatically the dies and punches at the end of the working stroke of the machine. The cross-hatched sections in this diagram indicate the cross-section of the shell at the end of each successive step in the operation. Fig. 4 shows cross-sections through actual shells to indicate the progressive forming of the inside and outside of a shell forging.

These dies are designed to produce two shells from one piece of bar stock. One end of the bar is heated to about 2200 degrees F., and then placed successively in the five die impressions for the forging operation. The opposite end of the bar is then heated and forged in a similar manner. This practice saves the material that would otherwise be required for gripping the bar with tongs while forging. The only waste material is a small neck



Shells for 75- and 105-Millimeter Guns Can Be Forged so Accurately in an Upsetting Machine of Modern Design that No Machining is Required on the Inside of the Forging

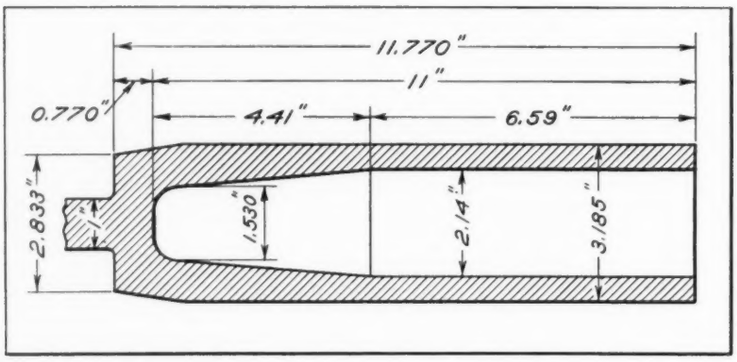


Fig. 1. Diagram Showing Important Dimensions of the 75-millimeter Shell Forged in the Upsetting Machine Seen in the Heading Illustration

left between the two forged shells, which is sheared off prior to machining. The forging blanks are 2 3/8 inches in diameter and about 28 inches long for a 75-millimeter shell of the dimensions shown in Fig. 1.

The first step in forging this shell is to place the bar stock in the upper die impression. When the header slide advances the punches into the die impressions, the upper punch centers the end of the bar and expands it slightly to form a collar or centering flange for the succeeding operations. This is a most important step, because the accuracy of the finished forging depends upon the bore being closely centered with respect to the axis of the solid blank. If the bore is started off center, the finished bore will not be concentric with the outside surface of the shell, as the punches used in the succeeding steps will naturally follow the center of the preliminary hole.

In centering the hole in this first step, the stock in the middle of the forging blank is also squeezed by the sidewise movement of two plates, or "nipping inserts," as a preliminary step in forming the neck between the two forgings. When the punches withdraw from the die impressions, the operator turns the stock about 90 degrees, and holds it in the same die impression while the header slide goes forward a second time. In this manner, the neck in the middle of the forging blank is shaped approximately round. This "nipping" of the neck is carried out also in the four following die impressions, and it is the practice to turn the stock 90 degrees as it is transferred from each impression to the next.

The punch that enters the second die impression from the top is pushed into the forging blank for a distance of approximately 3 inches. In the third die impression, the bore is extended for another 3 3/8 inches. In the fourth step, the bore is extended still another 3 3/8 inches, and is also tap-

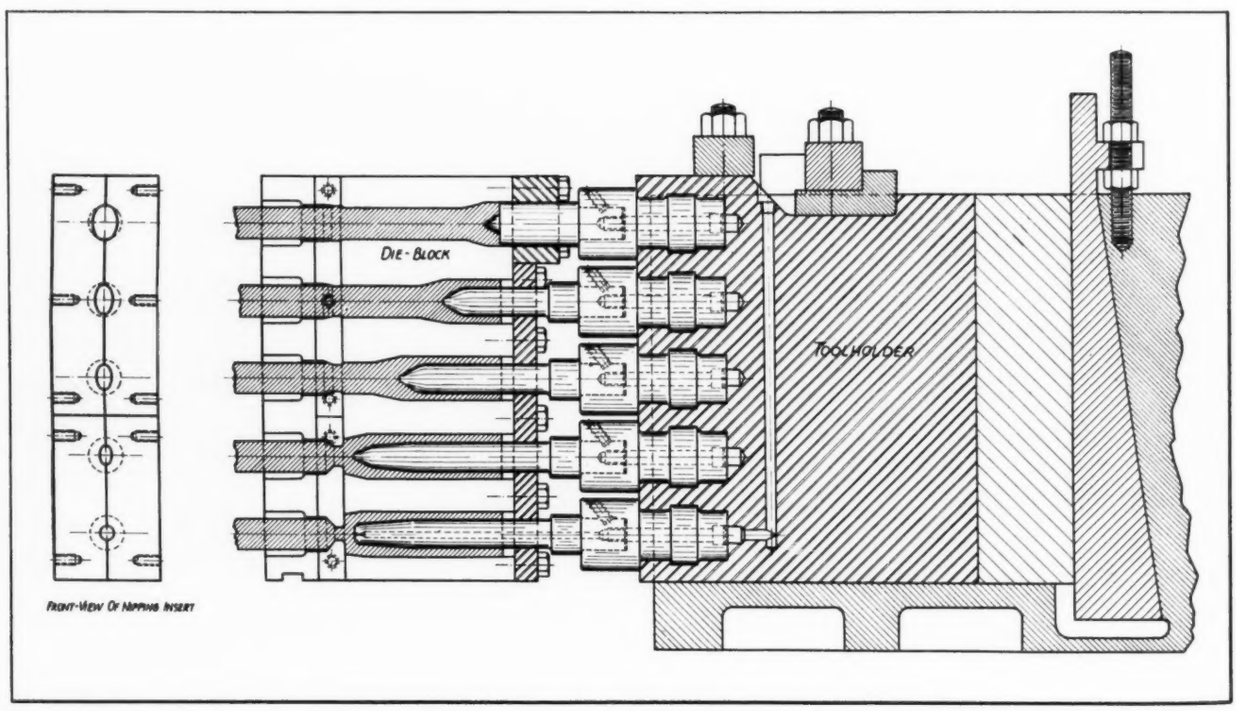


Fig. 2. Diagram that Indicates the Successive Steps in Forging 75- and 105-millimeter Shells

ered in the end that will become the closed end of the shell. Finally, in the fifth die impression, a finishing punch sizes the shell bore, which may have shrunk a little under size due to cooling of the forging during the operation.

A true center is maintained in the shell forging in all steps of the operation by guiding the punches in pilot holes contained in plates mounted at the front of one of the die halves, as will be seen in Figs. 2 and 3. These plates also serve as a stripper to prevent the forging from sticking to the punches during the return strokes of the header slide. The shells are customarily made from 0.40 per cent carbon steel having a yield point of approximately 60,000 pounds per square inch.

The machine is provided with a solid tool-holder, so that the punches can be readily changed for forging either 75- or 105-millimeter shells with the assurance that the centers of the punches and their corresponding die impressions will be in true alignment. The punches are made of hot-working steel. Water is applied automatically on the external surface of the punches each time they are withdrawn from the die impressions, as otherwise they would become excessively hot in producing as many as 75 forgings an hour. The sizing punch is made with a small vent hole extending its full length, so as to permit the escape of air trapped at the front end of the bore as the punch advances into the forging. The die-block is of sufficient volume to permit the heat to be dissipated rapidly, and so water cooling is not required.

Construction details of this 5-inch forging machine follow the design of similar machines in the XN line built by the Acme Machinery Co. The main shaft is of the eccentric type, and provides a large bearing area in the sliding head, which results in a low pressure per square inch and reduces

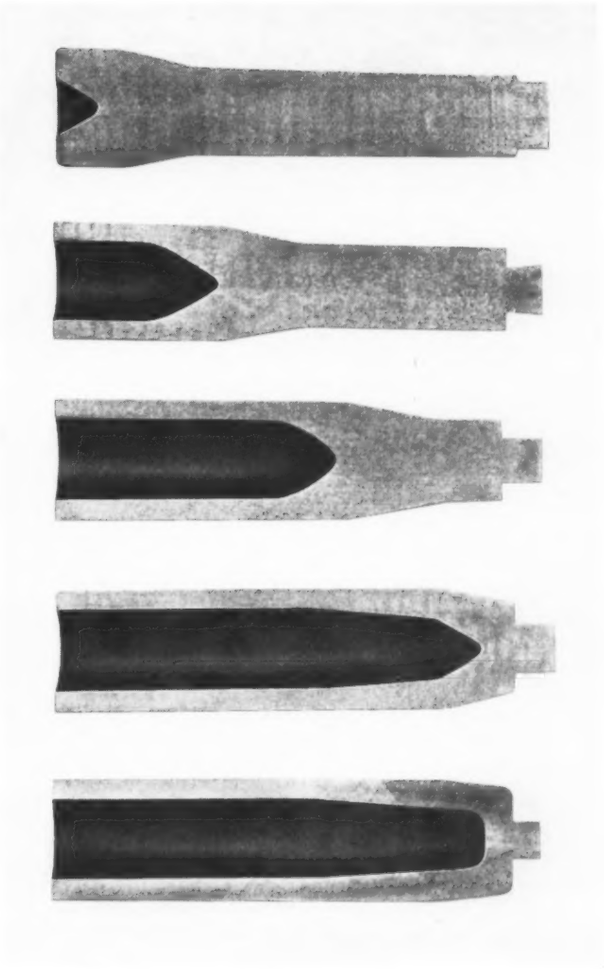


Fig. 4. Successive Steps (from Top to Bottom) in the Forging of Projectile Shells in a Horizontal Upsetting Machine

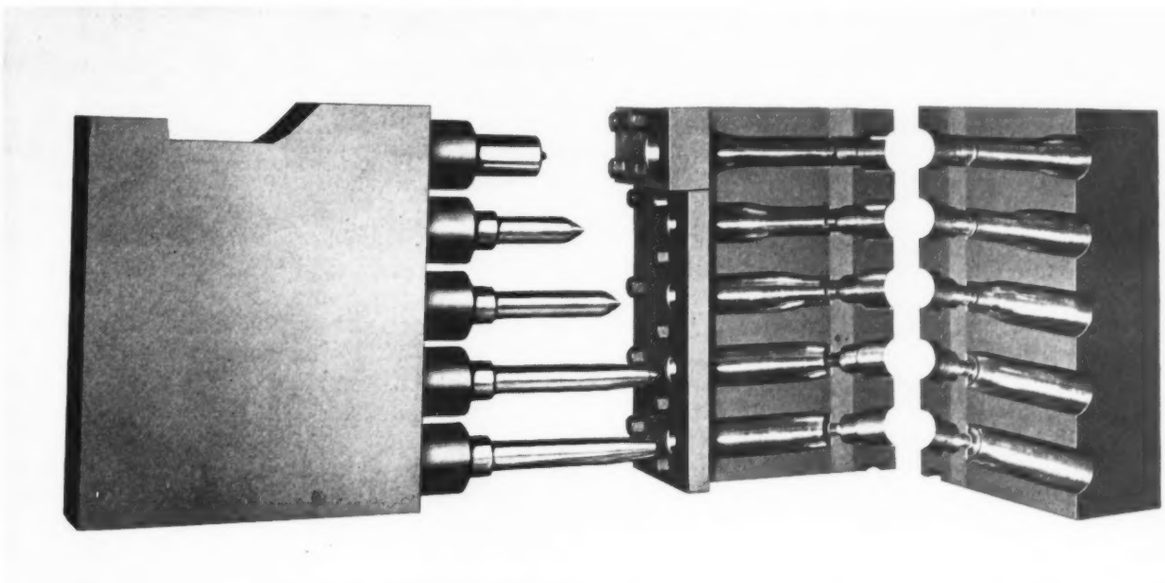


Fig. 3. The Die Halves, Punch-holder, and Punches Used in Forging Projectile Shells as Seen in Fig. 4

maintenance costs. The main-shaft bearings can be located close to the center line with this construction, thus eliminating crankshaft deflection under heavy stresses and enabling the production of forgings accurate in contour and dimensions.

The header slide is of the fully suspended type, with large horizontal supporting surfaces. The construction is such that there is no tendency of the slide to lift at the front or rear end with the punches placed above or below the center line of the slide. This is due to the fact that the pressure on the slide above or below the center line is taken on a large arc of the eccentric, and there can therefore be no fulcrum point. Advantages claimed as a result of this design include the maintenance of accurate alignment between the heading punches and the dies, and the reduction of wear on the horizontal supporting surfaces of the header slide. The machine is equipped with an air-operated cushion drive.

The movable die slide is also of suspended design. It is opened and closed by double toggles which are in a straight line when the die is closed, so that all pressure due to the upsetting action is taken in compression. The slide itself functions only as an aligning member for the dies and receives no torque from the upsetting operation.

Dies up to 30 inches deep, 26 inches long, and 8 1/2 inches thick can be accommodated by this 5-inch forging machine. The die opening is 7 inches. The header slide is 105 inches long over all, and has a stroke of 15 inches.

Low Melting Point Alloy Used in Work-Holding Devices

TO provide for holding small parts of square, rectangular, or irregular section while grinding necks or heads, for example, or performing drilling or other machining operations on one or both ends, the Precision Mechanical Laboratory, 119 W. 63rd St., New York City, is producing special-purpose chucks with the aid of a low melting point alloy.

Chucks heretofore used have had certain disadvantages in holding small, irregular stock. Four-jaw, independent lathe chucks, for example, are likely to be bulky, slow in production, and inaccurate, because each part to be held must be centered independently. Special fixtures, which are in the nature of two-jaw chucks, with dovetail slots or slip jaws, may require rather elaborate mechanisms for operating, if adequate production speed is desired. Spring collets of special designs are likely to be costly and difficult to obtain on short notice; they also have definite limits of capacity.

The new chucking method, however, is convenient and has wide application. It is accomplished without resort to shaping, milling, broaching, or other expensive machine work or any particular skill. Accuracy of centering and proper alignment are readily obtainable, and the chucks admit of insertion and removal of work with great rapidity by unskilled labor.

In making these special-purpose chucks, a plug representing the part or stock to be held is set in a shell that is mounted on an arbor or a cup that fits the spindle of the machine on which the chuck is to be used. A low melting point alloy, known as Cerromatrix, is then poured into the space between the part and the shell or cup, and after the alloy sets, the plug is pulled out by means of a special fixture. The excess alloy is then trimmed off, the clamping means installed, and the tool is ready for use.

With this method, practically any shaped piece can be accurately centered in an adequate holding device which can be used in lathes or milling machines of various types. In making the holding device, the actual centering of the part to be held is a matter of minutes when the proper set-up jig is used, and the pouring of the alloy is easily accomplished, even when the annular opening between the part and holder is only 1/8 inch. If the opening is very small, however, the new 5600 type of Cerromatrix alloy, which has a lower surface tension than the standard type, may be used, and if needed, the metal can be drawn into the cavity by vacuum.

It is recommended that the piece or plug around which the alloy is to be set be preheated until quite warm. Best results are also obtained if the alloy is allowed twelve hours to set, so that the greatest hardness may be obtained. After wear due to long use, the pouring process may be repeated to restore the chuck to its original accuracy.

The adaptability of the process to odd sizes and shapes has been amply demonstrated. The sizes for which the process has been used range from 1/8 inch to 2 inches square. In one application, this type of chuck was used for holding small parts for neck-grinding, with a production of from 420 to 480 parts per hour. This is indicative of the possibilities of the process where high production is required.

Cerromatrix is an alloy of bismuth, lead, tin, and antimony produced by the Cerro de Pasco Copper Corporation, New York City. It has a melting temperature of 248 degrees F.; a pouring temperature of 300 to 400 degrees F.; a weight of 0.343 pound per cubic inch; a tensile strength of 13,000 pounds per square inch; a compression strength of 16,000 pounds per square inch; an expansion (after solidification, cooling, and aging) of approximately 0.002 inch per inch; an elongation of less than 1 per cent; and a Brinell hardness of 19.

Cutting Oils and Their Application

Review of Various Kinds of Sulphurized Cutting Oils and Their Application to Different Types of Metal-Cutting Operations

By TRACY B. LANGDON, Vice-President
D. A. Stuart Oil Co., Ltd., Chicago, Ill.

DURING recent years, sulphurized oils have largely replaced fatty oil mixtures as cutting oils and cooling compounds for machining operations. Comparatively little has been published in the technical press, however, as to the exact application of the different sulphurized oils. In most machine shops, the application of cutting oils has been more or less of a cut-and-try matter, comparatively little definite information being available on the subject of the relationship of the cutting fluid to the machinability of metals of various kinds or its suitability for different machining operations.

While much research has been carried out on the subject, it is only recently that the results of this research have been made available to the engineers responsible for results in the machine-building and metal-working industries. The need for a scientific approach to the subject has long been recognized. Fully twenty-five years ago, the D. A. Stuart Oil Co. engaged in pioneer research on this subject, and as far back as 1920 made public to the leading small tool manufacturers and machine tool builders some of the information obtained on the relationship of cutting fluids to machinability. This research has been carried on steadily, and the information given in this article is based on the facts thus ascertained.

Different Types of Sulphurized Cutting Oils

There are five distinct types of sulphurized cutting oils: (1) Fatty or vegetable oils, with cooked-in sulphur; (2) fatty or vegetable oils, sulpho-chlorinated; (3) petroleum oil, with cooked-in sulphur; (4) petroleum oil, sulpho-chlorinated; (5) petroleum oil, with inert natural sulphur. The five types are listed approximately in the order of their development over a period of some twenty years.

Type 1. Fatty or Vegetable Oils, with Cooked-in Sulphur—This type of oil was developed somewhat more than twenty years ago. It revealed to industry for the first time that sulphur and fatty oil could be combined fairly homogeneously, and that, in machining alloy steels, a sulphurized fatty oil mixture gave far better results than the mixture of lard or sperm oil and mineral oil that had previously been employed.

This type of cutting lubricant is still widely used for machining alloy steel. Before dilution with paraffin blending oil, this type is usually of very heavy consistency—similar to molasses—dark in color, and has an objectionable hydrogen sulphide odor.

Type 2. Fatty or Vegetable Oils, Sulpho-Chlorinated—The process for making this type of oil was originated by the D. A. Stuart Oil Co. in 1918. With this process, it was possible to produce a much lighter-colored, heavy-bodied, sulphur-base oil without any objectionable odor. In this type, the added sulphur content is in true chemical combination with the oil, which, therefore, is permanent in character, no sulphur precipitation taking place even after the oil has been stored for a long period.

Owing to the sulpho-chlorination treatment and to the higher degree of oiliness, compared with the Type 1 oil, it is feasible to dilute it to a greater extent with low-cost blending oils. The mixtures take practically the color of the blending oil, providing a transparent sulphurized cutting oil. This type of oil is today in widespread and ever increasing demand, both for metal cutting and for metal stamping and drawing. In various mixtures, it is suitable for automatic screw machine work, automatic nut tappers, bolt-threading machines, broaching machines, gear-cutting machines, gun-drilling machines, and milling machines. It is also used for pipe and nipple threading, for upset bolt burnishing, and as a substitute for white lead on difficult work. A number of different mixtures of this type of oil have also been found suitable for deep drawing and stamping.

Type 3. Petroleum Oil, with Cooked-in Sulphur—As the utility of sulphur in cutting oil became better known, and as pipe-threading, in particular, was found to be more easily done by the use of sulphur in the cutting lubricant, the demand of the steel mills for a low-cost, light-bodied petroleum oil with sulphur added prompted the development of such oils with as much cooked-in sulphur content as the oil would retain in suspension.

In recent years, improved methods of manufacture have resulted in stable oils of this class having, in some cases, a permanent added sulphur content up to 2.5 per cent. It has also been pos-

sible to control the objectionable odor of such oil within reasonable limits, and it is, therefore, widely used today in various mixtures with the Type 5 petroleum oil referred to subsequently.

Type 4. Petroleum Oil, Sulpho-Chlorinated—This type of sulphurized cutting oil is a patented development of the D. A. Stuart Oil Co., brought out in 1926. The process enables a cutting fluid to be manufactured that is light in body, but retains, in true chemical combination, from 50 to 100 per cent more added sulphur than had formerly been thought possible. This type of cutting oil is especially effective in reducing tool loading and minimizing tool wear.

Type 5. Petroleum Oil, with Inert Natural Sulphur—During recent years, it has been found that lubricating oil refined from high-sulphur crude oil can be produced with a natural sulphur content up to 2.5 per cent. By adding active sulphur to this high sulphur content lubricating oil, a cutting oil is produced. It should be noted, however, that a high natural sulphur content lubricating oil by itself is not of great value as a cutting fluid, and that the value of the oil as a cutting lubricant is wholly due to the added active sulphur. Hence, the performance values of sulphurized oils of seemingly the same specification may vary widely, according to whether the sulphur is in the inert natural form or added active sulphur.

When to Use High or Low Added Sulphur Content in Cutting Fluids

Light-bodied oils containing the higher percentages of added sulphur (from 2.5 to 3.5 per cent) will give the best results as follows:

For securing better finish on machine parts, or smoother threads.

For overcoming chip welding or metallic pick-up.

For machining stainless and alloy steels, low-carbon steels—such as S A E-1010—steels with low Brinell readings, Monel metal, nickel, iron, copper and tough bronze.

For operations such as roughing gear teeth, threading, broaching, deep-hole drilling, and reaming.

For heavy feeds when the surface speed is correspondingly slow.

Light-bodied oils containing low percentages of added sulphur (from 0.2 to 0.7 per cent) will give the best results as follows:

For securing long tool life and lower oil costs.

For machining free-cutting steels, screw stock, and high-sulphur steels, machine steels, high-carbon steels, tool steels, high-speed steels, high Brinell reading steels, and non-ferrous metals.

For operations such as performed in high-speed automatic screw machines, gear finishing, thread milling, turret lathe work, drilling, and milling.

For light feeds when the surface speed is correspondingly high.

Unemployment Whys and Wherefores

"Something of the What, Why, and Where of Unemployment" is the title of a booklet, which is No. 34 in a series prepared by Allen W. Rucker in collaboration with N. W. Pickering, president of the Farrel-Birmingham Co., Inc. Based on a study of the U. S. Census of Manufactures' data, the authors show the restraining effects of existing labor and social legislation and excessive taxation on the expansion of job opportunity in manufacturing industries.

In analyzing this problem, they point to the decline in the number of going concerns between 1929 and 1937; the shrinkage in man-hours of work during the same period; the widening gap between population growth and employment opportunities; the decrease in physical volume of output; and the shifts in job opportunity.

In conclusion, the authors state: "From every standpoint, it is difficult to see how the persistent discouragement to large-scale enterprise, punitive and excessive taxation, and arbitrary wage rate and hour standards can do other than create and perpetuate the nation's most serious economic and social problem. If management can induce employes, legislators, and public officials to see the relation between profit possibilities and the number of going concerns, between these and the number of jobs, much of the task can be accomplished. It may be enough to remove the chief restrictions, and to encourage management to overcome the minor ones." This booklet can be obtained from the Farrel-Birmingham Co., Inc., Ansonia, Conn.

* * *

Standard Approved for Involute Splines

The American Standards Association has approved as an American Standard the proposal by Technical Committee No. 13 on Splines and Splined Shafts. The new standard is known as "Involute Splines, Side Bearing." The National Machine Tool Builders Association, the Society of Automotive Engineers, and the American Society of Mechanical Engineers are the joint sponsors for the newly approved standard. Copies of this standard can be obtained by addressing the American Standards Association, 29 W. 39th St., New York.

* * *

Lectures on Foundry Practice

The Detroit Chapter of the American Foundrymen's Association will present a series of six lectures on the fundamentals of foundry practice every Friday, beginning on March 1, in the Chemistry Lecture Room of the University of Detroit, at Livernois and McNichols Road, Detroit, Mich. The lecturers will be some of the most prominent men in the foundry industry.

Drawing and Forming Deep Tapered Shells

By M. J. GOLDSTEIN

MAKING dies for drawing deep shells with straight sides is not difficult, as compared with the production of dies for forming deep tapered shells, such as shown at *E*, Fig. 1. As the first step in making dies for shells of this type, the writer lays out templets for the finished shell and for the shells produced in the preliminary forming steps, as shown in Fig. 2.

The heavy lines in Fig. 2 represent the finished shell, and the dotted lines show the shape of the shell before the final stretching or drawing operation. A blank 11 1/2 inches in diameter is required for this shell. The metal used is 20-gage copper, 0.032 inch thick.

The first-operation die is shown in Fig. 3. This die consists of a tool-steel ring *G*, 11 1/2 inches in diameter by 1 1/4 inches thick. The ring is hardened and ground and is a force fit in the cast-iron holder or die-shoe. The opening is 6 inches in diameter, and the radius on the drawing edge is 7/16 inch. The surface and radius portions of the die are given a high polish after grinding, using an oilstone for the final finishing.

Three pins *H*, only one of which is shown, are used to locate the blank under the drawing punch.

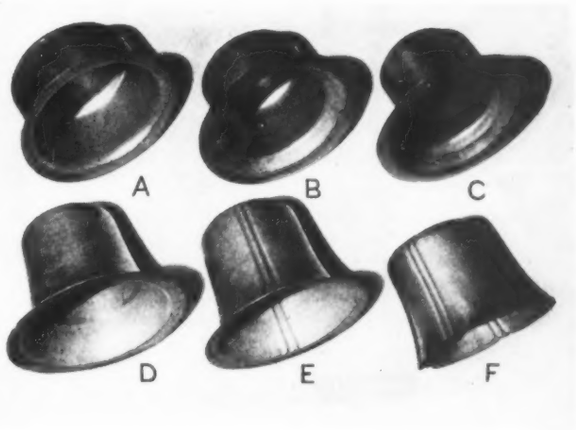


Fig. 1. Six Steps in Forming Shell F

The blank-holder *J* is a duplicate of the die ring *G*, except that there is no radius formed on the tool-steel ring. The punch is cold-rolled steel, threaded at *K* to fit the screw usually employed on drawing presses for punches of this kind. An air vent *L* leads to the outer air. Four 1/2-inch holes *M* are provided for use in tightening the punch on the nose-piece of the press ram. For this operation, as well as the following ones, an intermediate nose-piece having external and internal threads at opposite ends is provided to permit proper adjustment for the depth of draw.

The shell shown at *A*, Fig. 1, which was produced in the first operation, is drawn to a depth of 3 1/2 inches. The bottom edge of the shell is formed to an angle of 45 degrees. This angle is extended in subsequent operations to form the flaring portion on the finished shell.

The second-operation die is shown in Fig. 4. The die ring is tool steel, hardened and ground, and has a 45-degree angle on the holding surface.

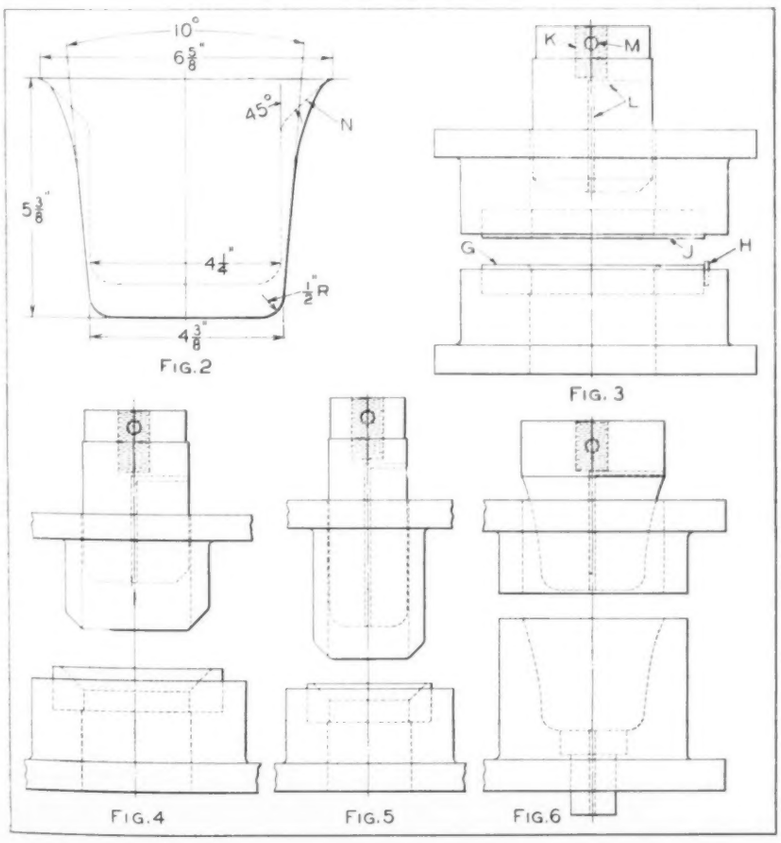


Fig. 2. Lay-out of Finished Shell and Dotted Outline of Shell before the Final Drawing Operation. Fig. 3. Diagram of First-operation Die Used to Form Shell A, Fig. 1. Fig. 4. Outline of Die Used in Second Operation to Produce Shape Shown at B, Fig. 1. Fig. 5. Diagram of Die Used for Second Reduction, which Forms Shell Shown at C, Fig. 1. Fig. 6. Die Used to Stretch Shell to Shape Shown at D, Fig. 1

The ring is a force fit in the cast-iron shoe. The blank-holder is a composite forging having a tool-steel body and a machine-steel flange. After being hardened, this holder is machined on the back or clamping surface and is ground internally. The outside of the body is ground, so that the shells formed in the first-operation die are an easy fit, and the end is ground to an angle of 45 degrees to match the die. The punch is cold-rolled steel. The shell, after being redrawn in this die to the shape shown at *B*, Fig. 1, has a body diameter of 5 inches and a depth of 4 inches.

The die for the second reduction is shown in Fig. 5. The design of this die follows closely that of the first redrawing die. The punch and blank-holder are, of course, somewhat longer. The punch has a radius of 1/2 inch at its lower end. After being redrawn, the shell has a diameter of 4 1/4 inches and a depth of 4 3/4 inches. The shell produced by this die is shown at *C*, Fig. 1, the flange being formed to an angle of 45 degrees, as indicated at *N*, Fig. 2.

The shell is next annealed and cleaned in a muriatic acid pickle after which it is put through the die shown in Fig. 6, where it is stretched to the shape shown at *D*, Fig. 1. The die shown in Fig. 6 is of cast iron, except for the knock-out member. After the previously drawn shell is placed in this die, the blank-holder descends and holds the flange while the punch enters the shell and stretches it to the finished shape. Obviously, careful planning is required in order to have the shell the right size before this stretching operation is performed, as a surplus of metal would cause buckling, while a shortage would result in broken shells.

Comparison of the shells *C* and *D*, Fig. 1, as they appear before and after stretching shows the flanges to be the same size. This indicates that the correct amount of metal has been drawn to form the shell properly without unduly affecting its strength. Additional stretching of the shell takes place in the last operation, which forms the shell to the shape shown at *E*, Fig. 1. This additional stretching, however, is incident to the forming of the ornamental ribs.

The die used in the drawing press for forming the shell to the shape shown at *E* is of novel construction. To save the cost of expensive hand finishing work on the cast-iron die member, the casting was made larger than required and an alloy consisting of 94 per cent zinc and 6 per cent aluminum was poured into the space between the punch and die-castings to form a die cavity of the required shape and size, as shown in Fig. 7. The alloy used for this purpose is the same as that employed for ornamental cast novelties, and is known as "unbreakable metal." The melting point of this metal is about 800 degrees F. Very little finishing work was necessary on the cast die, a little scraping with a hooked tool to give clearance for the shell being all that was required. This die showed hardly any signs of wear after forming several thousand shells. The punch was held in a special adapter on the nose-piece of the press ram designed to prevent it from turning or getting out of alignment.

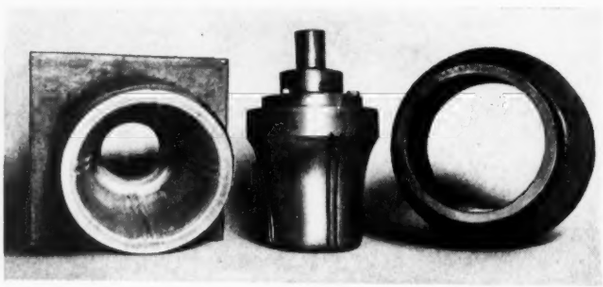


Fig. 7. Punch and Die for Forming Shell to Shape Shown at E, Fig. 1

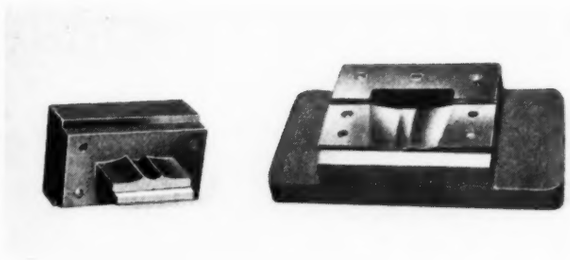


Fig. 8. Die Used for Trimming Edge of Shell to Shape Shown at F, Fig. 1

The flange on the shell was next trimmed off on a trimming lathe, and the edge formed by a trimming die mounted in a foot-operated press. The die used for this trimming operation is shown in Fig. 8. This die is made in two sections, the back part being 1/4 inch higher than the front part to provide a guide for the edge of the shell. The front section is formed to fit the shell. The higher back section of the die plus the heel on the punch prevents the punch from being sheared.

* * *

Once More, the Man Over Forty

Harry J. Klingler, general manager of the Pontiac Motor Division of the General Motors Corporation, referring to the Pontiac plant, has this to say about workers over forty years old: Of the entire wage-earning force, 25 per cent are over forty years old; nearly 300 are over sixty years old; and 9 are over seventy. Many operations require skilled performance, which is achieved only through long experience. Many of the unskilled jobs in automobile plants do not call for speed or strength. Workers between the ages of forty-five and sixty draw the highest annual earnings.

Referring to automobile plants in general, the survey shows that more than half of the men over forty were past forty when hired. Of the men working on jigs, fixtures, tools, and dies, in various automotive plants, from 30 to 52 per cent were hired after their fortieth birthday.

Manufacturing Preparedness at Watertown Arsenal

Applications of Modern Machine Tools in Producing Component Parts for Big Guns at the Watertown Arsenal

By COLONEL ROLLAND W. CASE
Commanding Officer
Watertown Arsenal, Watertown, Mass.

IMPORTANT operations performed in the rough-turning, rough-boring, and straightening of large gun tubes, and in finishing component parts for gun mounts were described in an article published in July, 1939, MACHINERY. This article will describe additional operations that illustrate the manufacturing preparedness which arsenals can attain if provided with machines of modern types.

The gear department, which is equipped with modern machine tools, is often called upon to improvise methods of doing the job because of the small quantities of gears of one kind required. A typical example is illustrated in Fig. 1, where a fly cutter is shown being used on a Gould & Eberhardt hobbing machine to gash out the stock between the teeth of a steel worm-gear, about 15 inches outside diameter. The outline of the fly cutter approximates that of the spaces between the gear teeth. Ordinarily, a hob would be used for this operation, but the cost of a hob would have been prohibitive in this case, as only three gears were required.

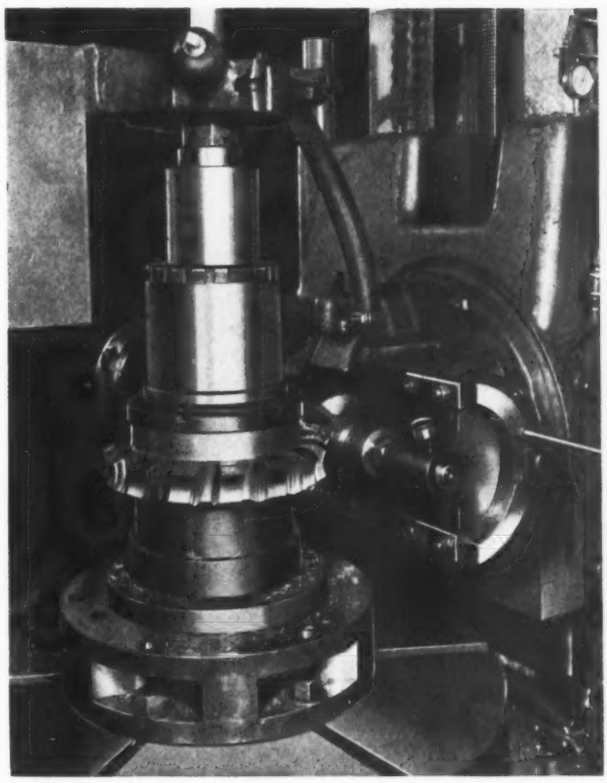


Fig. 1. Employing a Form Fly Cutter for Gashing out a Steel Worm-wheel, of which Only Three were Required

Upon the completion of this tooth cutting operation, the teeth were filed and scraped to the correct form, as checked by reference to a master worm mounted in the Gleason gear testing machine illustrated in Fig. 2. High spots were readily determined by applying red lead to the gear teeth.

An ingenious method of finishing internal and external spherical surfaces is shown in Fig. 3, the operation being performed on a LeBlond engine lathe equipped with the regular compound rest at the front of the cross-slide and a special swiveling tool-head at the back. The part being operated on is a cast-steel leveling socket for an anti-aircraft gun. It is first turned on the

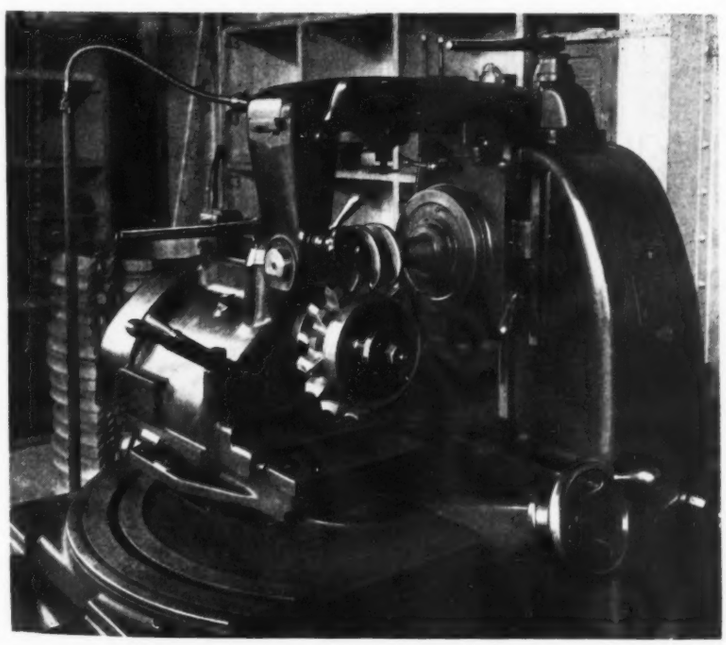


Fig. 2. The Worm-wheel, Rough-cut as Shown in Fig. 1, was Filed and Scraped to Fit a Master Worm on a Gear Testing Machine

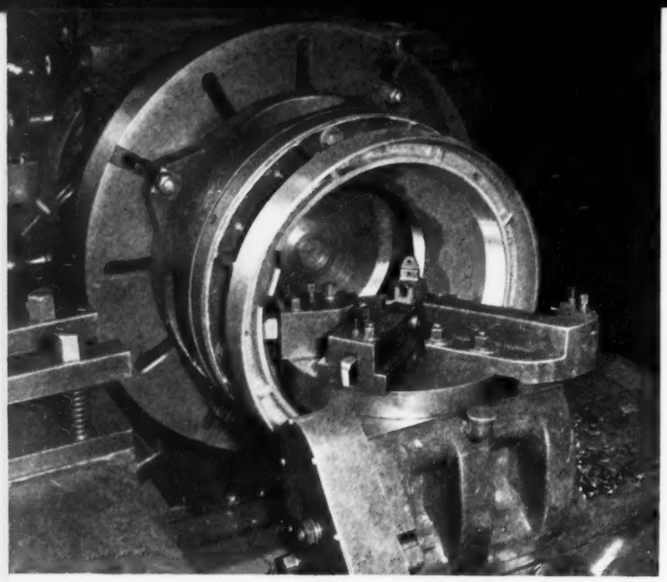


Fig. 3. A Special Tool-head on an Engine Lathe Enables Internal and External Spherical Surfaces to be Machined on Leveling Sockets for Anti-aircraft Guns

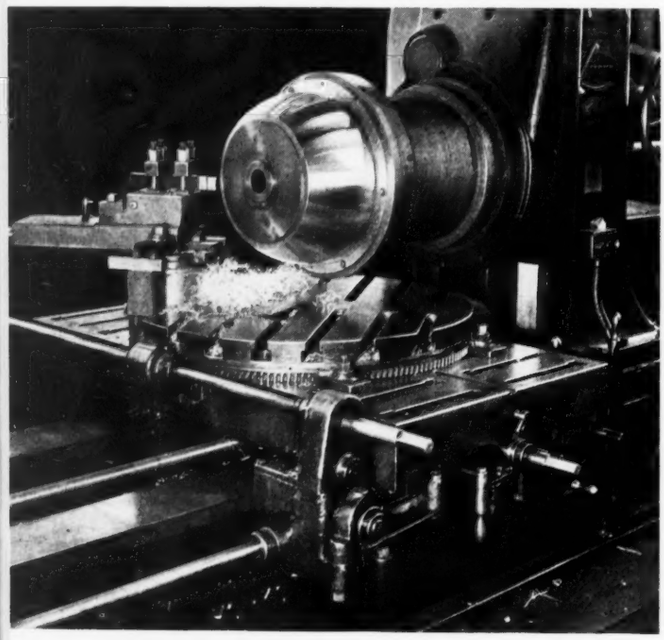
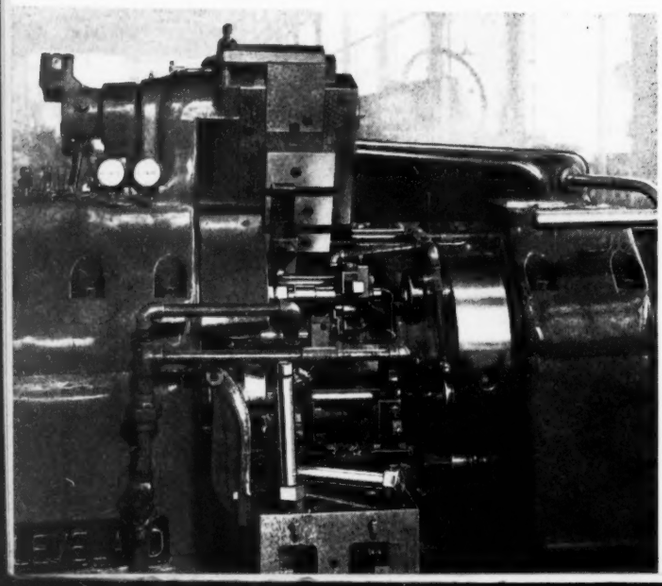


Fig. 4. (Above) Tooling Arrangement for Turning Bronze Spheres that Fit Sockets Shown in Fig. 3. Fig. 5. (Below) A Cleveland Automatic Used for Producing Large Bolts



periphery to a double taper by using a tool on the compound rest, after which the special tool-head is positioned as shown for the spherical machining.

The work is then rough- and finish-bored to a radius of 10 inches as two tools on the left-hand side of the tool-head are swiveled around the internal spherical surface by applying the regular power feed of the machine. Upon the completion of these cuts, a hook type tool mounted in the holder seen on the right-hand side of the tool-head is advanced through the work and extended through the hole at the back end of the casting for turning a companion external spherical surface. This surface must be larger in radius than the internal surface by an amount equal to the thickness of the wall and is about 2 1/2 inches long. All dimensions are held within 0.001 inch.

The bronze leveling spheres which mate with the sockets machined in the manner just described are turned, as illustrated in Fig. 4, in a special set-up on a horizontal boring mill. The work is mounted on a fixture attached to the regular cutter-spindle of the machine, and the turning tool is supported on a circular table mounted on the regular machine table. After the circular table has been positioned correctly relative to the center line of the work and the tool set at the desired radius, the work is turned by merely revolving the circular table to carry the tool around the work.

A Cleveland four-spindle automatic designed for handling bar stock up to 2 5/8 inches in diameter is shown in Fig. 5 engaged in producing 7/8-inch bolts, 8 inches long, from 1 1/2-inch hexagon stock. Ten tools on the front, rear, and overhead slides, and on the central carrier, produce the bolts shown at the front of the machine at the rate of one every nine minutes.

The Watertown Arsenal has made great advances in the fabrication of welded-steel gun mounts. A typical structure is shown in Fig. 6 on a machine that enables the welder to turn the work about two centers in order to bring every joint that is to be welded into a horizontal plane. The United welding positioner shown has a capacity for holding a weight of 1000 pounds at a point 12 inches distant from its table. Each structure is first tack-welded in jigs, and then placed on one of these positioners for complete arc-welding. About 500 feet of welding is performed on a structure such as shown. The rotation of the positioner table about its own center, and the swiveling of the table around a horizontal axis, are both accomplished by motor drives, actuated when the welder depresses push-buttons with his left foot. Furnaces have recently been installed for relieving these welded structures of stresses.

Any article about the Watertown Arsenal would be incomplete without reference to the extensive laboratory that is maintained here by the Ordnance Department for conducting researches on ferrous metals. The scientific staff of this laboratory is constantly engaged in a search for cleaner metals, steels that will resist gun-firing erosion to the maximum degree, and tools that are capable of machining the tough steels produced.

Extensive tests are conducted on finished guns and their mounts to prove that they will withstand the severe service to which they will be subjected. Complete gun mounts, side frames, outriggers, and other units up to 30 feet in length can be tested in the huge machine shown in Fig. 7, which has a capacity for applying pressures up to 800,000 pounds in tension tests and up to 1,000,000 pounds in compression tests. Although sixty years old, this machine is still one of the most precise in the world. As part of its acceptance test back in 1879, this machine not only had to give accurate readings of 1,000,000 pound-loads but also of the small loads required to break horsehairs and eggshells!

* * *

Hampering Business Cannot Promote National Welfare

Business at almost every turn finds itself subject to control by administrative agencies with quasi-legislative and quasi-judicial powers. How is business to conduct itself correctly if it cannot ever know the rules of the game? How can we adjust ourselves to laws conceived on the spur of the moment by those to whom power has been delegated or to regulations imposed by those who blandly assume power?

We are stumbling into a bureaucratic despotism, which is demoralizing to the whole system of private enterprise. Industry would do well to study, and Congress would do well to pass, the Walter-Logan Measure, which defines and limits administrative law already run rampant.—*Howard Coonley in his annual report as president of the National Association of Manufacturers*

* * *

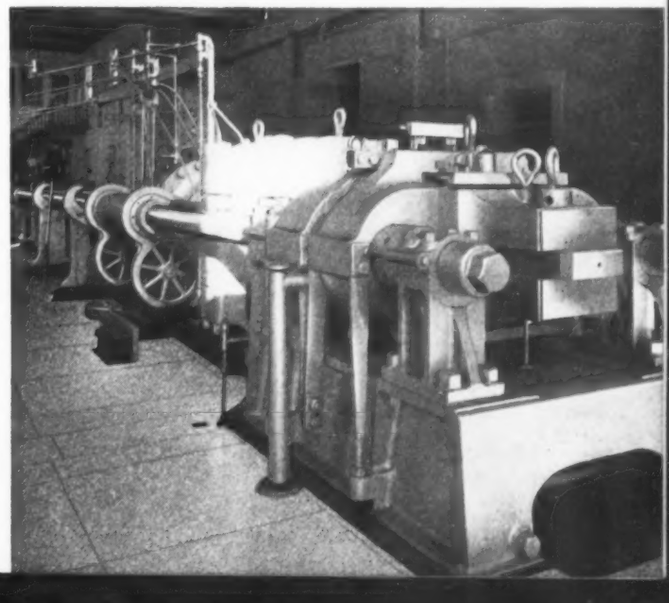
What an Industrial Concern Means to a Community

In an address made before the annual meeting of the Society of Automotive Engineers, W. L. Batt, president of the S K F Industries, Inc., Philadelphia, Pa., called attention to the far-reaching importance of even a small industrial plant in a community. As an example, he took a small factory having about 150 employes, located in a small town, where it is the principal industrial enterprise. Such a factory, typical of those distributed throughout the country, represents an investment in plant and equipment of approximately $1,000,000. The annual payroll runs to about $180,000, and provides direct support for about 600 people. But indirectly, this factory provides the main support for some additional 500 working people in the community. These include those who own and work in thirty-three retail stores and in the gasoline stations and service shops for 320 automobiles; the plumbers, carpenters, painters, decorators, etc., required to build and maintain the 400 homes in the community; two dozen professional men; and the teachers who serve the community.

Fig. 6. Fabricated Structures Such as Shown are Conveniently Arc-welded by the Use of Welding Positioners which Enable the Work to be Turned about Two Centers

The railroads collect $53,000 annually from the factory, and the town uses farm products from an area of perhaps close to 7000 acres. The retail sales in the community reach over $500,000 annually. The total taxable valuation of the town is $2,500,000; and throughout the town, in the course of a normal year, the almost unbelievable sum of $7,000,000 in checks and cash payments cover all the transactions made. All this originates chiefly from a single small industrial manufacturing unit. Is it worth while for Government to encourage industry, or should the efforts of industry be discouraged, as they have been during the last seven years? When one realizes how many people get their livelihood from a single medium-sized manufacturing concern, this question is one that cannot be easily brushed aside. It is not only the 150 employes that are concerned—it is their families also, and all the tradespeople of the town.

Fig. 7. Huge Machine in the Research Laboratory, Capable of Applying a Pressure of 800,000 Pounds in Tension Tests and 1,000,000 Pounds in Compression Tests



Coming Annual Meeting of Tool Engineers

THE annual meeting of the American Society of Tool Engineers will be held on March 7 to 9 at the Hotel New Yorker, in New York City. This promises to be the largest and most important meeting held by the Society up to the present time. No less than thirty speakers, well known throughout industry, will aid in making this meeting one of real engineering significance.

"Economics of Tooling" will be the main theme of the meeting. Contributions on this subject will be made by B. G. Tang, general superintendent, Schenectady Works, General Electric Co.; W. F. Stegemerten, superintendent of equipment and methods, South Philadelphia Works, Westinghouse Electric & Mfg. Co.; J. M. Crawford, assistant superintendent, Generator and Motor Section, General Electric Co., Schenectady, N. Y.; F. E. Darling, Wage Standards Department, Eastman Kodak Co., Camera Works, Rochester, N. Y.; and W. J. Peets, assistant superintendent, Singer Mfg. Co., Elizabethport, N. J.

"Precision Small Gears" will be the subject of another session. The speakers will be Thomas Turner, manager, Meter Division, Westinghouse Electric & Mfg. Co., Newark, N. J.; George H. Sanborn, Fellows Gear Shaper Co., Springfield, Vt.; Arnold Thompson, chief designing engineer, Canadian Acme Screw & Gear Co. of Canada, Ltd., Toronto, Ontario; and a representative of the Barber-Colman Co., Rockford, Ill.

"Tooling for Plastics" will be dealt with by Joe E. Stewart, general foreman, Plastics Department, Ford Motor Co., Dearborn, Mich.; W. B. Ross, Die Molding Co., Canastota, N. Y.; and F. W. McIntyre, vice-president and general manager, Reed-Prentice Co., Worcester, Mass.

Another subject to be discussed will be "Screw Machine Tooling," various phases of which will be covered by H. P. Berry, editor, *Screw Machine Engineering* and senior tool and gage designer, Naval Gun Factory, Washington, D. C.; M. W. Taylor, foreman, Screw Machine Department, Wright Aeronautical Corporation, Paterson, N. J.; C. G. Stevens, mechanical superintendent, New Departure Division, General Motors Corporation, Bristol Conn.; and L. G. Gilbert, manager, Time and Methods Department, Columbus-McKinnon Chain Corporation, Tonawanda, N. Y.

"Punches and Dies" will be dealt with by W. T. Forde, manufacturing supervisor, International Business Machines Corporation, Endicott, N. Y.; Gordon L. Reed, chief engineer, York Corrugating Co., York, Pa.; and Frank D. O'Brien, master mechanic, Tool Department, Eastman Kodak Co., Camera Works, Rochester, N. Y.

Papers will be presented on the subject "Cutting Tools and Materials" by E. S. Chapman, general works manager, Plymouth Division, Chrysler Corporation; W. G. Robbins, president, Carboloy Company, Detroit, Mich.; and A. H. d'Arcambal, Pratt & Whitney Division, Niles-Bement-Pond Co.

"Training in Tool Engineering" will also receive attention. The field of tool engineering has been growing fast, but educational facilities for the training of tool engineers have lagged behind. On this subject, addresses will be made by Clifford S. Stilwell, executive vice-president, Warner & Swasey Co., Cleveland, Ohio; J. W. Barker, dean of the College of Engineering, Columbia University; B. L. Bowsher, superintendent of schools, Toledo, Ohio; and Thomas P. Orchard, of the Technical Evening Classes, Paterson, N. J.

Proper Maintenance of Spot-Welding Electrode Tips

MAINTENANCE of a predetermined size and shape of electrodes and correct alignment of the electrodes are of utmost importance in spot-welding if consistently good welds are to be obtained. This conclusion was reached after an investigation made by Wendell F. Hess and Robert A. Wyant of the department of metallurgical engineering at Rensselaer Polytechnic Institute, Troy, N. Y., and reported to the Society of Automotive Engineers at its meeting in Detroit last January.

Improper alignment causes hot spots in both weld and electrode contact faces, with consequent poor joints and rapid electrode wear. Because a small percentage of change in contact area produces a corresponding change in current density, the strength of the welds is seriously impaired. Consistent results cannot be obtained by hand-dressing of electrode tips after they have lost their shape through prolonged use.

During the investigation, flat-faced electrode tips were used, and these were removed for reshaping when the change in contact area approached 5 per cent. In reshaping, the tips were machined slightly under size. They were then replaced in the holders and brought together to a snug fit. This was done by using a fine, thin, flat file. Great care was taken to avoid rounding the edges. In checking the area and alignment, a sheet of paper was wrapped around a piece of the material to be welded. The electrodes were then brought together under full welding pressure. When they were in good alignment, the uniformity of pressure was indicated by a perfectly circular impression on the paper.

Gear Materials and Their Heat-Treatment

By EDWARD J. WELLAUER
The Falk Corporation, Milwaukee, Wis.

General Requirements in Gear Materials and Recommended Heat-Treatments—Abstracted from a Paper Read before the American Gear Manufacturers Association

IN considering materials employed for modern gear requirements, we find steel to be most widely used because of its broad range of characteristics, different kinds of steels being suitable for each specific application.

For carburized gears, the carbon content is usually within the range of 0.15 to 0.25 per cent. Steels with a lower carbon content are selected to secure maximum tooth toughness. The higher carbon contents are used to obtain maximum core strength. The present trend is toward the use of a steel having a carbon content of from 0.20 to 0.25 per cent, which is suitable for gas carburizing or activated baths.

Gears heat-treated before machining should be made from a steel having a carbon range of from 0.30 to 0.45 per cent, when the steel is to be water-quenched. Steels ranging from 0.40 to 0.60 per cent carbon are used when they are to be air- or oil-quenched. Gears that are to be hardened after the teeth are cut should have from 0.45 to 0.55 per cent carbon. In all cases, the carbon content should approach the upper limit when the size of the gear increases and also when the required hardness increases. By using alloy steels, it is possible to have a lower carbon content. This will increase the toughness and make gears cut after heat-treatment more easily machinable.

Alloy steels are used to improve (1) the durability of the gear-tooth profiles—that is, to make the gears wear-resistant; (2) the strength of the teeth, or the ability to withstand tooth breakage; and (3) both durability and strength.

The surface durability depends upon the surface hardness. Alloy steels that can be heat-treated for great hardness (chromium, manganese, and molybdenum steels) are specified when surface durability or high static strength is required.

Maximum resistance to tooth breakage caused by shock or impact is secured by using nickel, vanadium, or molybdenum alloy steels. Fortunately, some alloy steels have both great surface durability and dynamic strength and toughness.

The success of a gear as a power-transmitting medium depends to a great extent upon the accuracy and finish of the tooth profile. Therefore, alloy steels having additions of molybdenum, sulphur, or lead, which improve the machinability and surface finish, are especially suitable for gears that are cut after heat-treatment.

Gear steels usually specified as fine-grained have better dynamic properties and show less distortion in heat-treatment than coarse-grained steels. The latter, again, are preferable when maximum hardness or easy machinability is important.

Experience has shown that profile wear is a function of the Brinell hardness. In the ordinary hardness ranges, the tensile strength has also a fairly uniform relation to the Brinell hardness. For the general industrial gear which must have surface resistance to wear and abrasion, it is more important to specify hardness than other physical properties, assuming that the hardness is obtained by the best possible heat-treating procedure.

Cast Iron for Gears

It is difficult today to evaluate exactly the position of cast iron in the gear industry, because of the recent developments in the technique of cast-iron founding through which entirely new cast irons have been produced. Cast iron, however, is not as versatile nor as flexible as steel in regard to its response to various heat-treatments. The quality of cast iron depends to a large extent upon foundry practice. The addition of alloy metals, however, has much the same effect on cast iron as on steel. Nevertheless, the usual application for cast iron is where light loads, a minimum of shock, and low speeds are met with. Because of the great improvements in cast-iron foundry practice, the term cast iron can no longer be used without explicitly stating the analysis and physical properties desired.

The high "damping capacity" of cast iron has been held to be a desirable property in gears. It is doubtful, however, whether the damping capacity is sufficient to be of any measurable value in gears. The present knowledge of the subject does not permit accurate conclusions to be drawn.

The real value of cast iron as a gear material is usually determined by the cost factor. Even if cast iron is not equal to a suitable steel for gear service in general, it should rightfully be considered, when it can be secured and processed to meet the required service conditions more economically.

Steel Castings for Gears

The successful use of steel castings for gears depends to a great extent on both design and foundry practice. A cast gear must be designed and poured with special consideration of the quality of the metal in the rim. Shrinkage strains and porosity must be given consideration, and several other metallurgical factors must be controlled. Steel castings for gears should have from 0.30 to 0.45 per cent carbon. For the larger sizes of gears, the alloy content would be from 0.90 to 1.50 per cent manganese, with one of the following: from 0.15 to 0.40 per cent molybdenum; 0.75 to 1.25 per cent nickel; or 0.10 to 0.20 per cent vanadium.

An important phase of gear steel casting manufacture is the heat-treatment, which is used to refine the "as cast" structure and to relieve the casting strains. To refine the structure and make it homogeneous requires that the ferrite phase be dissolved. This is accomplished by a high-temperature treatment, from 1625 to 1750 degrees F., followed by air or furnace cooling. The "air cool" or normalizing treatment is preferred, because the rapid cooling rate prevents the ferrite from precipitating in its original massive form.

Low-carbon cast steels that are not to be quenched are usually given but one high-temperature treatment. Alloy steels are sometimes given another air quench from 1475 to 1550 degrees F., depending upon the size and composition, followed by a draw to bring the hardness within the proper range. A 0.40 per cent carbon, 1.25 per cent manganese, 0.20 per cent molybdenum steel is very suitable for gears, especially gears of large size.

Steel castings for gears that require very high physical properties should be liquid-quenched and tempered.

Hardening of Gear Materials

Experience has shown that in the heat-treatment of industrial gears, profile durability must be given more consideration than resistance to breakage. Generally speaking, a heat-treatment that will provide durability will also give more than sufficient strength to carry the load.

Fundamentally, there are two hardening methods: (1) Surface hardening and (2) full hardening. Surface hardening can be obtained by (1) carburizing, (2) activated baths, (3) nitriding, and (4) flame hardening.

Carburized Cases—The fundamentals of carburizing are so thoroughly known that little explanation is required. The choice of steel and the carburizing treatment depend largely on the use to which the gears are to be put, as well as the production facilities available. For small gears, plain carbon steel is usually satisfactory. Heavy loads, high speeds, or excessive shock conditions demand an alloy steel.

Light or Activated Cases—A thin case of from 0.008 to 0.020 inch is sufficient in some applications to provide surface durability. The usual light case is obtained by means of an activated bath or a special gas high in carbon and nitrogen. These cases, however, are inclined to be brittle, especially if the carbon content of the steel is high. Steel with a carbon range of from 0.30 to 0.45 per cent is usually employed.

Nitrided Cases—The nitrided case is very high in nitrogen and is the hardest possible case. Nitrided cases have been successfully used for aircraft gears, pump gears handling abrasive compounds, etc. Recent improvements in nitriding steels have eliminated some of the difficulties formerly encountered. The process results in low distortion; but the special steel, the long treating period, and the equipment required increase the cost so that the process is not commercially suitable for many industrial applications.

Flame-Hardening — Flame-hardening is used when it is desired to surface-harden gears that are larger than can be economically handled in carburizing equipment or when the size or shape of the gear makes a full quench unsatisfactory. The flame-hardening process has been given considerable publicity recently, so that there is no need to describe it in detail in this connection. A flame-hardened gear should be tempered at from 300 to 600 degrees F. immediately after hardening. The steel used for flame-hardening should have a carbon range of from 0.30 to 0.45 per cent.

Gears Heat-Treated before Machining

Most commercial gears used for speed reducers, steel mill units, high-speed turbine reduction sets, pump drives, etc., call for such smoothness of operation and freedom from noise that the errors that would be introduced by heat-treating after cutting the teeth are not permissible. Therefore, such gears are cut after they have been heat-treated.

The carbon content of gears cut after heat-treatment varies from 0.30 to 0.60 per cent. Steels with the lower carbon contents are used where small sections occur in the gears and in connection with alloy steels; higher carbon contents are suitable where larger sections are encountered. For ordinary commercial pinions, the maximum hardness for economical machinability is about 320 Brinell. Special steels with controlled sulphur content and grain size can be machined if the hardness is within the range of 320 to 400 Brinell.

Whenever possible, the blanks are liquid-quenched and tempered to secure the maximum refinement for a given hardness. When large or complicated sections are encountered, liquid-quenching is hazardous, and normalizing or annealing is resorted to. A normalized section should have a hardness below 290 Brinell in order to maintain a satisfactory ductility.

Even in large gears (20 inches in diameter and over) a normalized alloy steel produces excellent results. Hence, there is a trend toward the use of

Physical Properties of Gear Steels

Physical Properties	Chromium-Nickel-Molybdenum Steel		Manganese-Molybdenum Cast Steel
	Normalized and Drawn	Liquid-Quenched and Tempered	Double-Normalized and Drawn
Yield Point, Pounds per Square Inch	85,000	105,000	56,000
Tensile Strength, Pounds per Square Inch	112,500	135,000	90,000
Elongation in 2 Inches, Per Cent	23	20	24
Reduction in Area, Per Cent	52	55	50
Brinell Hardness	235–270	270–300	180–200

alloy steels for such gears. The physical properties given in the accompanying table can be obtained through properly carried out heat-treatments.

It is customary to use a pinion that is somewhat harder than its mating gear to obtain better wearing conditions. A heat-treated pinion should be specified, regardless of the condition of the gear.

Small gears in automotive, aircraft, machine tool, and small gear-reducer applications are frequently heat-treated after cutting. The advantage lies in obtaining, at low cost, a hardness above the machinability range. These gears are made from steels with a carbon content of from 0.40 to 0.55 per cent which contain hardening alloys such as chromium and molybdenum, with nickel or vanadium as toughening agents. There is less distortion in gears fully hardened after cutting than in carburized gears, but they are not so tough. To obtain a file-hard surface, it is usually necessary to heat in a salt bath or a special atmosphere.

The Accompanying Illustrations Show an Example of Excellent Industrial Lighting. The Picture Below Shows a View of One of the Designing Departments in the Plant of the Heald Machine Co., Worcester, Mass., Taken in Daylight, with no Artificial Illumination. The Illustration at the Right Shows the Same Room Photographed

at Night, with the Same Exposure and no Other Light than that Supplied by the Regular Lighting Fixtures. The Lights are Combination 400-watt Mercury and Incandescent Lamp Diffusers, Giving 55 Foot-candles at all Points at Working Height, as Compared with 60 Foot-candles of Daylight on a Bright Day

Engineering News Flashes

The World Over

New Meter for Measuring Shaft Horsepower

A new electric meter has been developed by the General Electric Co. for giving accurate and instantaneous measurements of shaft horsepower of ships. With the new device, the engineer can check the performance of his propulsion equipment over a wide range of speeds, can compare the rate of fuel consumption with power output under varying conditions, and, in general, can check the efficiencies of boilers and other equipment. Readings can be taken directly from the scale on the dial of the meter, thus eliminating the need for conversion formulas and tables.

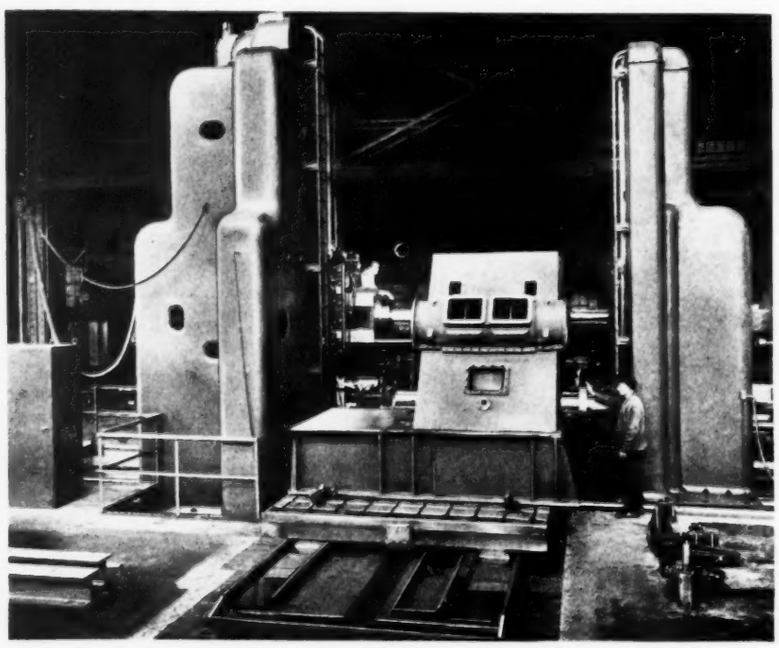
The new meter consists essentially of two electric generators, mounted on the propeller shaft and connected to indicating devices which can be located any distance away. The generator rotors are built in halves, which are assembled on the shaft after the latter has been installed in the ship. The stator bearings are also made in halves, the stator structure being assembled on the rotors after they are in place. The stator is restrained from rotating.

The stators of each generator are initially adjusted so that when no torque is being transmitted by the revolving shaft, the voltages generated by the two generators are exactly 180 degrees apart in phase. Thus, these voltages balance each other, the resultant voltage being zero and the indicator hands standing at zero on the dial. When a load is placed on the revolving shaft, the torque will cause a small amount of twist in the shaft, and the two voltages will no longer be 180 degrees out of phase; the resultant voltage, being proportional both to the shaft twist and to the propeller speed, will register on the dial as an indication of the horsepower.

The indicating portion of the instrument can be either a continuous indicator showing instantaneous horsepower or a meter showing total horsepower-hours, or both. A further refinement can be supplied in the form of an automatic log record, in which the instantaneous power is recorded on a moving roll of paper throughout the voyage.

Fluorescent Inks Make Drawings Appear in Bright Colors

Fluorescent inks which glow under ultra-violet rays are being used in sales promotion work, according to the *National Sign Journal*, by companies making Neon light installations. Drawings made with fluorescent inks, when exposed to "black



A huge Ingersoll horizontal boring and drilling machine has been installed in the South Philadelphia Works of the Westinghouse Electric & Mfg. Co., primarily for boring and facing large marine reduction gear housings. The machine weighs approximately 400,000 pounds, and is supported on a foundation containing 300 cubic yards of concrete with 25 tons of steel reinforcing rod. The total length of the bed is 44 feet, and the table is 10 feet wide by 20 feet long. The spindle can be raised to a height of 15 feet above the table. Eleven motors furnish the power for this machine, ranging from the 1/2-H.P. motors used in clamping to the 25-H.P. motors for the spindle drives. In a test, the machine removed 100 cubic inches of metal per minute.

light" equipment, will emanate light in full colors. This method gives the sign company a chance to show a prospective sign purchaser what the completed illuminated display will look like in the dark.

Permanent Magnet Lifts and Holds 4450 Times its Own Weight

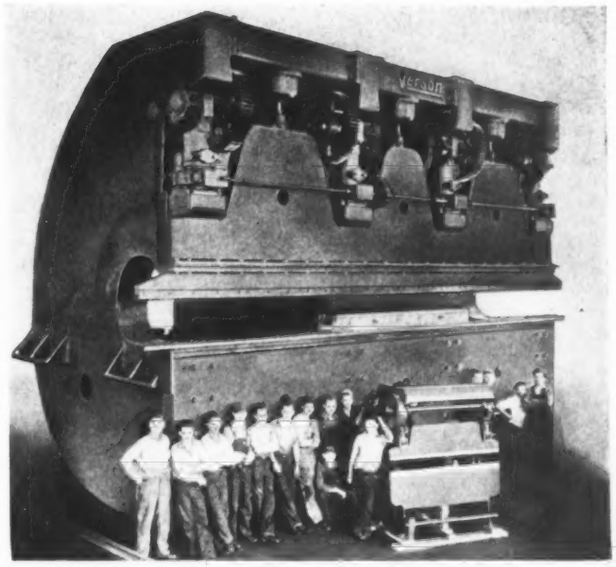
A new permanent magnet assembly, three times as strong as any previously made, has been developed by the General Electric Co.'s research laboratory. It is produced from sintered Alnico, an alloy of aluminum, nickel, and iron as the basic or essential ingredients, made by pressing together the powdered metals and heating almost to the melting point. By itself, without any special assemblage, the Alnico magnet has a normal lifting power of five hundred times its own weight; but the mounting of brass and iron, in which the magnetic flux passes through many air gaps instead of the usual two, in bridging from pole to pole, is responsible for the greatly increased power. The new assembly is not a commercial development, being as yet a laboratory product. Though smaller than a thimble and weighing but three-fourths of an ounce, this magnet, in its mounting, has supported over 200 pounds in tests, or 4450 times its own weight.

MIT Builds Experimental House to Test Possibility of Using Sun's Heat

An experimental house designed to trap the sun's heat as it falls on the roof and store it in the basement for various uses, has been built by the Massachusetts Institute of Technology. This house will be used in a research carried on to determine the possibility of utilizing solar radiation.

The purpose of the investigation is to study various possibilities of solar heat, including its use for the heating of houses, air-conditioning, and power generation. In the basement of the specially designed laboratory house is a large well insulated water storage tank, in which will be collected the heat from the sun's rays, the heated water being conveyed from the roof. The building is heated or air-cooled by forced air circulation, so arranged that the flow of air can be either over the hot tank surface or through the coils of a refrigeration system. This refrigeration system, operating on an absorption principle, will utilize sunlight as its heat source.

The research is one of several important projects planned to investigate solar energy. This work has been made possible by a gift of nearly $650,000 made last year by Dr. Godfrey L. Cabot of Boston for research on the utilization of solar radiation for practical purposes. The studies are being carried on under the direction of Professor Hoyt C. Hottel of the Massachusetts Institute's department of chemical engineering.



A Verson Mechanical Press Brake Designed for Bending 5/8-inch Steel Plate, 33 Feet Long, to a 90-degree Angle at One Stroke. The Total Weight of the Machine is 440,000 Pounds

World's Largest Press Brake Used in the Fabrication of Barges

What is said to be the largest press brake ever constructed has recently been built by the Verson Allsteel Press Co., Chicago, Ill. This is a 1000-ton mechanical press brake designed for bending 5/8-inch steel plate, 33 feet long, to a 90-degree angle in one stroke. The machine operates with either six or twelve strokes per minute and a 5-inch stroke. Each housing weighs 44,000 pounds. The total weight of the machine is 440,000 pounds. The machine is employed for the fabrication of barge sections.

Experiments to Run Automobiles on Acetylene Gas

The scarcity of gasoline, both in the nations engaged in war and in the neutral countries in Europe, has encouraged experimentation with other automobile engine fuels. For many years, experiments with acetylene gas have been carried on in Sweden. As far back as during the late World War, automobiles were actually driven with acetylene gas—apparently with indifferent success, however, since nothing was done with it for years afterward. Now the problem has been revived, and the experiments have met with reasonable success. The gas can either be generated directly in equipment mounted on the truck or automobile or it can be carried in compressed gas cylinders. It is estimated that medium-sized automobiles could be driven approximately thirty miles on the contents of a reasonable-sized cylinder such as could be carried conveniently.

EDITORIAL COMMENT

Every employer who wishes to do his share in creating better understanding between employer and employe should realize that no matter how small his business, he can perform a service with regard to industrial public relations. The term "public relations" has a tendency doubtless to scare off the average small employer. He points to the larger companies and says: "That is a job for the big fellow who can afford it, but not for me." This is where he is wrong.

"Public relations" simply means creating a friendly feeling toward business in general, on the part of both the public and labor. This job can often be done even more effectively in a small plant than in a large one. Obviously, there is closer contact between management and employes in a smaller plant, and the owner or manager can do much, personally, to establish friendly relations. In the larger plant, the duties must be delegated, and the manager can act only in an advisory and supervisory capacity.

There is an Important Job for the Smaller Industrial Plants

There is no doubt that industry, in the past, has not given sufficient thought to creating understanding and cooperation between itself, on the one hand, and the public and labor, on the other. Management has been so busy doing its productive job —furnishing better goods and more goods at less cost—that it has not recognized that its efforts in this direction may be greatly hampered by misunderstanding on the part of the public and of labor. The attack on business by Government and the readiness with which employes have listened to the exhortations and promises of labor leaders indicate the extent to which industry has failed to make the importance of its place in our national set-up understood.

Homer D. Sayre, Commissioner of the Metal Trades Association, recently made an address in which he pointed out that the employes of American industry—labor, if you wish—are one of the largest and most important parts of what is generally referred to as the public. Frequently, we divide our people into three groups, speaking of them as employers, labor, and consumers. But what are employers and employes except consumers? And who, in the last analysis, is the employer? Why, any man who has a few dollars in the savings bank is an employer, because his money—his capital—is used in business or industry to employ other people.

The employes of American industry are actually employers, consumers, and taxpayers; they also are an important factor in forming public opinion. American industry, therefore, has an amazing opportunity to obtain a favorable hearing at the bar of public opinion, if it is only successful in obtaining a favorable hearing before its employes; and in this work, a small business can accomplish as much as a large corporation.

Politicians, in order to shift the blame for their failure to restore normal conditions in industry and agriculture, always call upon industry to provide more jobs. Few of them have any idea of what it costs to provide a job in industry. A recent study of eight large Toledo manufacturing plants, operating in several different fields and able to furnish data over a period of years, shows that an average investment of $4219 is required in machinery, buildings, and equipment for every employe. In one of the plants, this investment is as high as $27,480 per employe; the lowest figure for any one plant is $1051. Somebody has to save and provide this amount of money for building the plant and buying machinery before an industrial job is available.

It Sounds so Easy: Industry Ought to Provide More Jobs

Technical writers often make the mistake of using many more words than necessary to describe a machine, mechanism, or process. Some writers like to use words of foreign extraction or words that sound scientific or learned. The use of such words should be discouraged; there is no need for them. The simpler the language used in technical writing, the better. High sounding words or flowery language is not the mark of a good writer, either in a mechanical journal or elsewhere. The clearer the thought, the more easily can it be conveyed by simple everyday expressions.

The Technical Writer at His Best Uses Few and Simple Words

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Foot-Operated Mechanism for Transmitting Rotary and Linear Movements

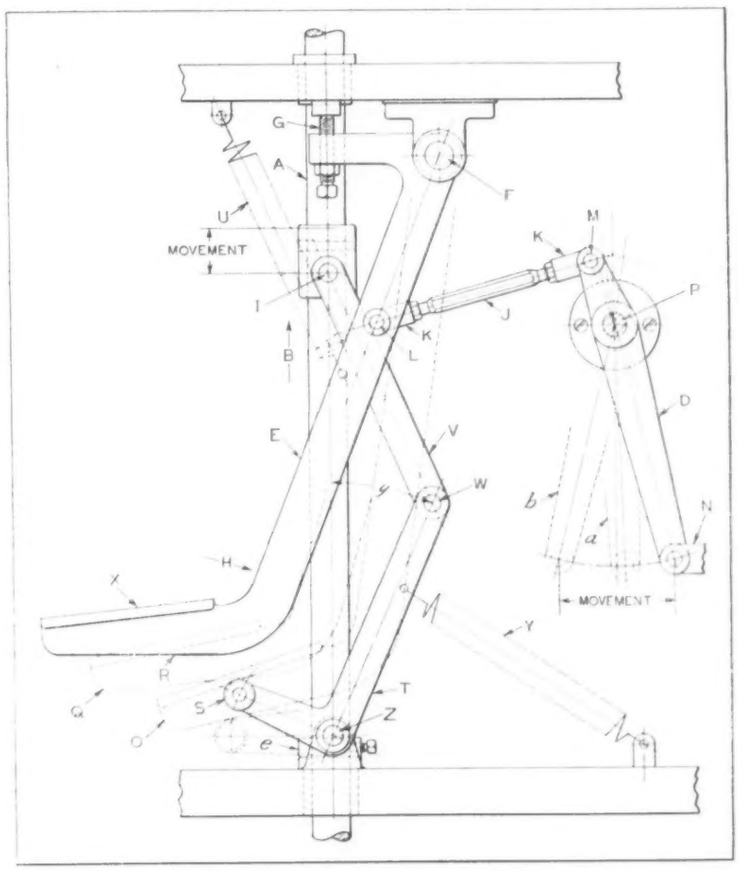
By FRANK HARTLEY

The natural movement of the operator's leg as it swings a pedal forward is utilized in the mechanism here illustrated to transmit a rotary motion to lever *D*, and, at the same time, impart an upward motion to shaft *A*, in the direction indicated by arrow *B*. The rotary motion occurs during the first part of the swinging movement of the foot-lever. Foot-lever *E* used for this purpose pivots on stud *F*. A stop-screw *G* locates the foot-lever in its starting position.

The operator, with his foot on the lever at *X*, kicks it back in the direction indicated by arrow *H*. At the beginning of the stroke, lever *D* is caused to move through the medium of connecting-rod *J* attached by adjustable rod ends *K* to studs *L* and *M*. This movement is transmitted by connecting link *N* to a unit within the machine on which it is employed. Lever *D* rocks on shaft *P*, which is supported in bearings in the end frames of the machine.

When pressure of the foot at *X* has moved the lever to the position indicated by the dotted lines at *Q*, lever *D* will have been rotated to the position indicated by the dotted lines at *a*, and surface *R* will be in contact with a roll at *S* on bellcrank *T*. The remainder of the foot-lever action, which carries lever *E* to position *O*, moves lever *D* to position *b*, and is utilized in actuating the toggle lever of which crank *T* and link *V* form a part. A vertical movement is imparted to shaft *A* through toggle connecting-link stud *W* traveling along path *y*.

Bellcrank *T* pivots on and is supported by a fixed stud *Z*. Link *V* is pivotally attached at *I* to a block pinned to shaft *A*. The effect of this toggle linkage and rotary lever action is to combine a crosswise movement of connecting link *N* with a delayed vertical movement of shaft *A* when the foot-lever is given a full swinging movement from the position shown by full lines to that shown at *O*. A spring *U* serves to return the foot-lever to its starting point. Another spring at *Y* returns bellcrank *T* and shaft *A* to their starting points which are determined by collar *e*.

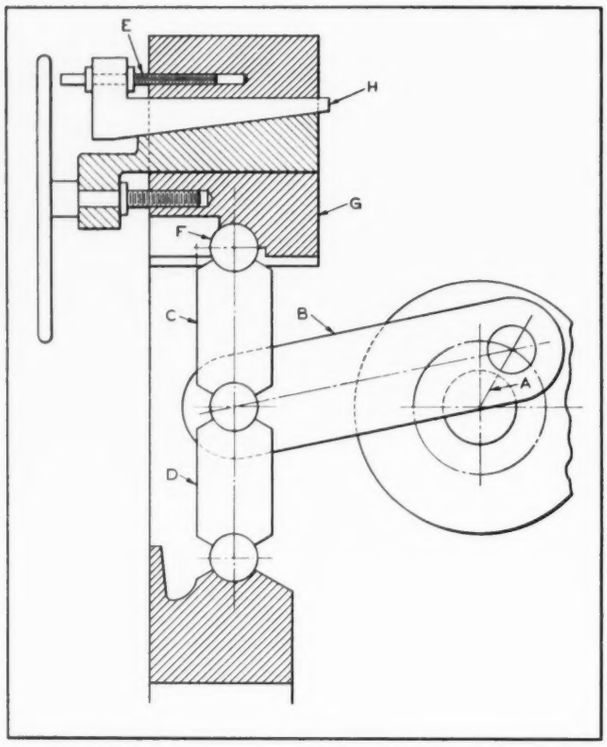


Foot-operated Mechanism for Transmitting Rotary Motion to Lever D and Vertical Movement to Shaft A

Variable-Stroke Toggle-Lever Mechanism for Press

By PAUL GRODZINSKI

The stroke of most presses operated by an eccentric cannot be changed, because the amount of eccentricity is fixed. However, only a slight adjustment of the position of the top bearing of a toggle-lever press is required to obtain a consider-



Toggle-lever Mechanism Designed to Permit Adjustment of Position and Length of Press Ram Stroke

able range of adjustment in the length of the stroke. Crank *A* of the toggle-lever press mechanism shown in the accompanying illustration transmits motion to toggle levers *C* and *D* by means of connecting-rod *B*.

The upper lever is located in a bearing *F* on a slide *G* which can be moved or adjusted in a horizontal direction at right angles to the direction in which the press ram moves. The adjustment of slide *G* is effected by a handwheel which operates an adjusting screw. Thus the rigidity of the press body is not impaired by the adjusting device. The positions of the press ram at the ends of its stroke can also be adjusted by means of the screw *E* and wedge *H* without changing the length of the stroke. The press-operating mechanism described, which is the invention of W. Klocke, is covered by a British patent.

Automatic Variable-Speed Control Maintains Constant Cutting Speed when Facing Disks

By FRANCIS A. WESTBROOK

An automatic speed control applied to a Gisholt Simplimatic lathe in the machine shop of the Reeves Pulley Co., Columbus, Ind., makes it possible to maintain a constant cutting speed when facing disks. In other words, the number of revolutions per minute of the work decreases as the tool moves toward the circumference of the disk.

The machine is used for turning and facing disks in sizes up to 20 inches in diameter. The drive consists of a motorized mechanical variable-speed transmission with mechanical automatic speed control, arranged so as to provide a uniform cutting speed as the tool moves from the smallest diameter at the hub to the largest diameter at the circumference.

The speed control device is connected by a cable to the cross-feed of the lathe. As the cutting tool moves outward from the hub of the disk being faced, its movement is transmitted through the cable to the indicating lever of the mechanical variable-speed device, which, by means of a chain drive, transmits power to the speed control unit. The latter, in turn, is connected through a reducer and coupling to the drive-shaft of the lathe. Thus, as the cutting tool moves out, the motorized variable-speed transmission drive unit is automatically regulated to reduce the number of revolutions per minute of the disk, thereby maintaining a uniform cutting speed.

* * *

British War Industries Expand

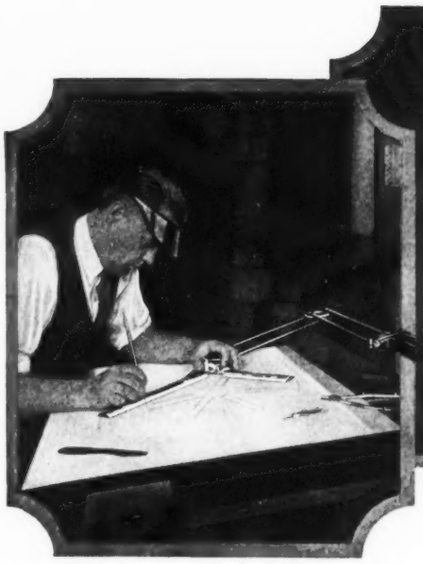
The manufacture of war material is proceeding at a rapid pace in Great Britain. Twenty new government ordnance factories, erected at a total cost of approximately $200,000,000, have been placed in operation since last September, and three hundred privately owned plants have been increased in size at a cost of about $45,000,000. During the first four months of the war, contracts amounting to considerably more than $1,000,000,000 were placed by the Ministry of Supply, not including so-called "continuing contracts" for raw materials. Of this amount, approximately $55,000,000 was for machine tools.

The output of shells has doubled since the beginning of the war. During the last four months of 1939, shell production was ten times greater than during any equal period in the last war. During 1940, the rate of output of guns will be greater than the final peak production attained in the last war.

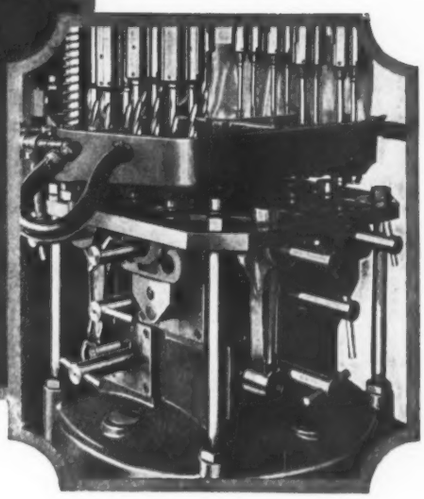
* * *

Labor Recognizes Serious Consequences of Government's Attitude Toward Business

The recent pronouncement of the Executive Committee of the American Federation of Labor regarding unwarranted government interference with business ought to be called to the attention of all men working in industry, whether they be members of the American Federation of Labor or not. The Executive Committee said: "We urge that all government actions that tend unnecessarily to discourage business expansion cease, and a positive effort be made to encourage industrial activity."



Design of Tools and Fixtures

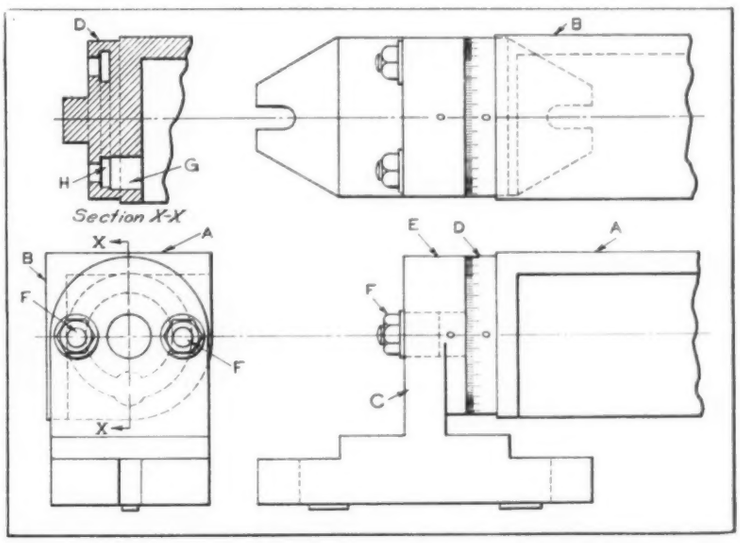


Fixture for Use in Milling Beveled Work

By ROGER C. DICKEY, Hudson, N. H.

Having experienced difficulty in setting up a milling machine to handle the tapered or beveled work frequently encountered in our plant, we built the milling attachment shown in the accompanying illustration. Surfaces *A* and *B*, to which work can be clamped, are at right angles to each other. Each of these work-supporting surfaces is 29 inches long by 4 1/8 inches wide.

The completed fixture consists of three members —two end pieces *C*, only one of which is shown, and the member with the work-supporting surfaces *A* and *B*. The work-supporting member has circular pieces *D* at each end corresponding to the top ends *E* of the end pieces. Both of the pieces *D* attached to the work-supporting member are graduated to 90 degrees each side of the center line. By loosening the nuts on the two screws *F* in the end pieces *C*, the work-supporting base can be swiveled to any angle desired. As the face of the work-support is about 4 inches wide, the work can be clamped to it from either side, so that the clamps will not interfere with the cutter. A hole *G* is provided to permit inserting screws *F* so that their heads are located in the annular groove *H* in the graduated piece *D*.



Fixture with Work-supporting Surfaces A and B that can be Tilted to Permit Machining Beveled Work

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Projection Welding Fixture for Production Work

By H. B. FAUGHT, Burbank, Calif.

The projection welding fixture shown on page 112 is essentially a high-production device. It is designed for welding the two cold-rolled steel parts *A* and *B*. Part *A* is the commutator end of a motor case, while part *B* serves as a mounting base for the motor. Another part (not shown), similar to part *A*, completes the motor case when assembled to part *A* by means of two studs. The time cycle required to join these parts by welding, as shown in Fig. 2, is 1 1/4 seconds. The floor-to-floor time is 3 seconds.

The fixture operates upon much the same principle as a forming die, except that the guide pins are inverted and the guide-pin bushings are reversed. The se-

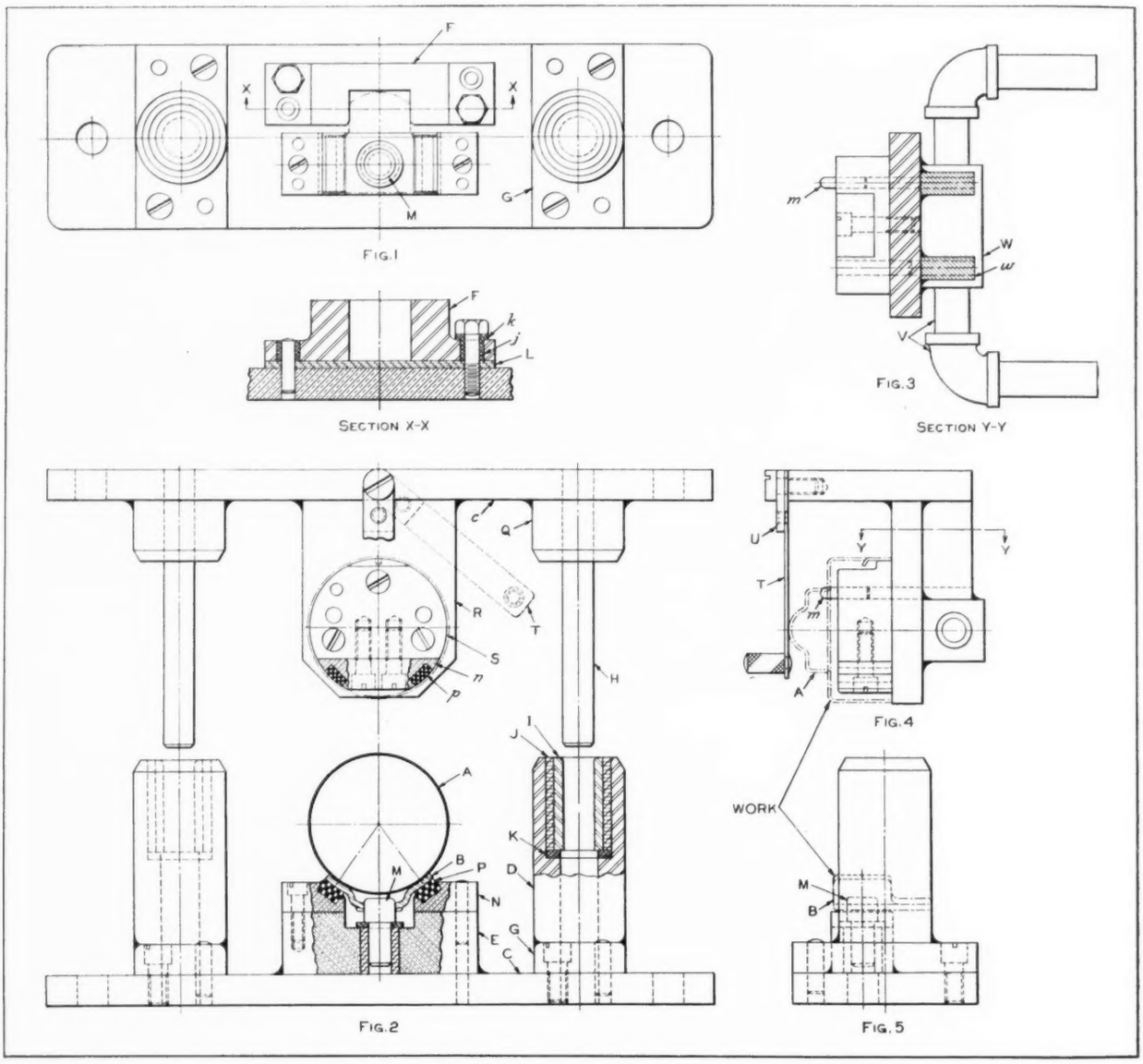


Fig. 1. Plan View of Welding Fixture Base. Fig. 2. Fixture Designed for Welding End A of Motor Case to Base B. Fig. 3. Arrangement of Water Pipes for Cooling Work-holding Member of Welding Fixture. Figs. 4 and 5. Side Views of Work-locating Members of Fixture

quence of operations in joining the two parts by welding is as follows: Referring to Figs. 1 and 2, part *B* is inserted in nest *F* and dropped over the pilot-pin *M*, the semicircular portion resting on electrodes *P*. Part *A* is next placed on pad *S*, where it is located by pin *m*, Fig. 3, which enters a 3/16-inch hole, as shown in Fig. 4. This brings work *A* in the proper location for assembly with part *B*. Spring clamp *T* is then swung to the center for holding work *A* in place, the operator being required to use both hands to operate a safety trip (not shown in the illustration).

When the safety device has been tripped, part *A* is brought to bear on four welding "dimples" embossed in part *B*, which causes an electrical contract to be formed through parts *A* and *B*. At the same time, these parts are subjected to an air-cushioned squeezing action between the upper and lower members of the fixture until the welding dimples are melted and part *B* is thus welded to part *A*.

The lower member of the fixture (the plan view of which is shown in Fig. 1) consists of a copper baseplate *C*, on which are mounted two steel guide housings *D*, copper adapter *E*, and steel locating nest *F* which is also shown in section *X-X*. Housings *D* are welded to steel plates *G* which are secured to baseplate *C* by screws and dowels to facilitate alignment of the hardened guide pins *H* with the bushings *I*, which are also made of steel and hardened. Housings *D* are equipped with auxiliary bushings *J* and washers *K* made of fiber or other material which provides adequate insulation.

Referring to the cross-section view *X-X*, it will be noted that nest *F* is also insulated by washers *k*, bushings *j*, and plate *L*, all of which are made of

fiber. The pilot-pin *M* is also insulated as shown in Fig. 2. Electrode blocks *N* are secured to adapter block *E* by screws and dowels to facilitate adjustment after dressing down electrodes *P* to remove pitted or burned surfaces. The blocks are raised to the proper height by means of copper shims. Electrodes *P* and *p* are made of a special alloy which stands up better than ordinary copper, especially on cylindrical or circular work which requires a welding current of greater amperage.

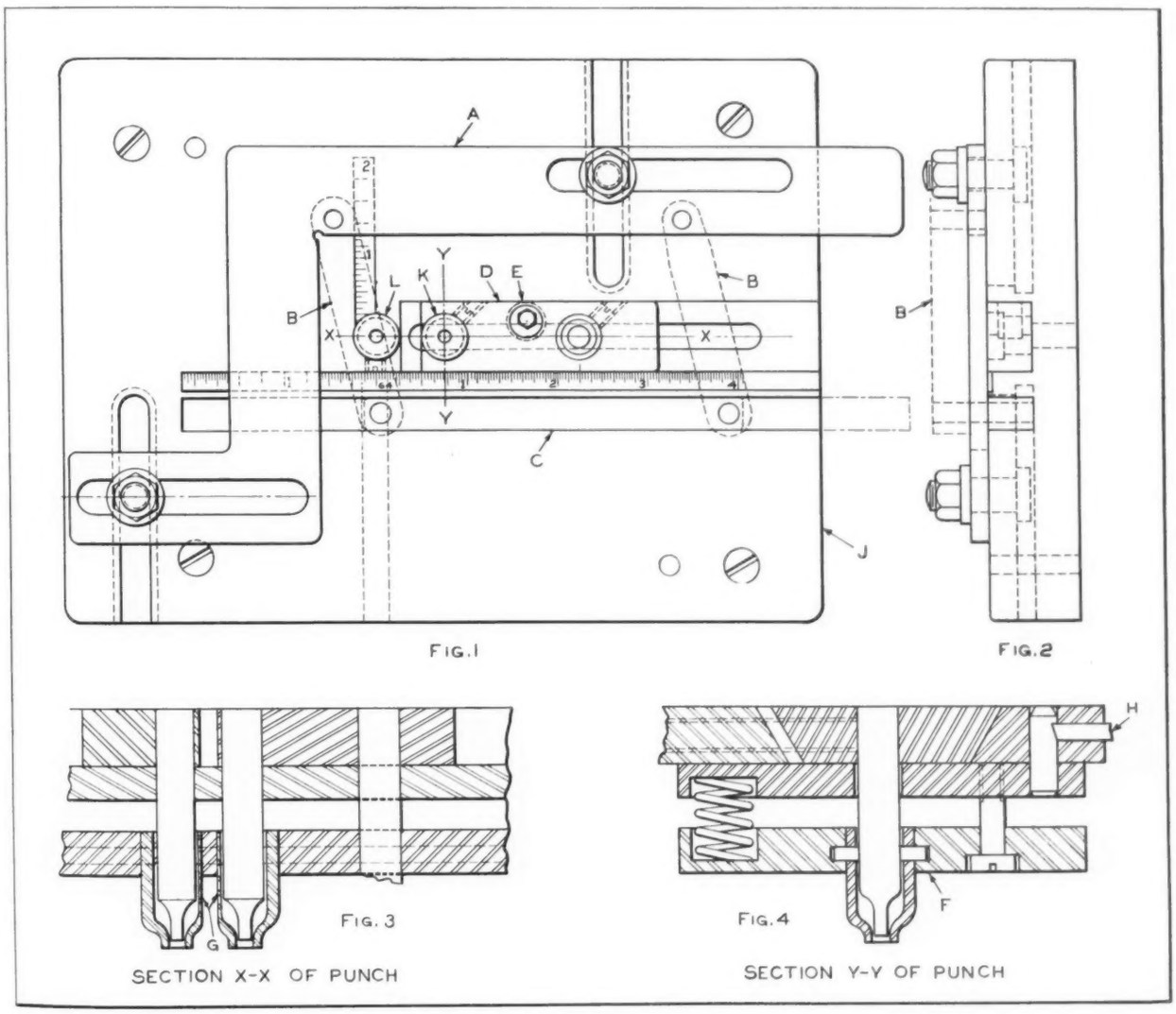
The upper member of the fixture shown in Fig. 2 consists of a copper plate *c* to which is welded two steel guide-pin bosses *Q* and copper adapter plate *R*. A copper locating pad *S* is secured by screws and dowels to plate *R* which, in turn, carries the copper electrode-holder *n*. Electrode-holder *n* is retained by two cap-screws, being adjusted by means of copper shims. Both upper and lower electrodes are brazed in place. Spring clamp *T* is reinforced by steel plate *U* to insure the necessary tension on work *A*. Guide pins *H* and bushings *I* are made in commercial sizes.

Piping *V*, as shown in Fig. 3, is incorporated in the fixture for water-cooling the upper member to avoid distortion of work *A*. The two ribs *w* and block *W* are made of copper and are welded to plate *R*. The upper and lower members of the fixture are clamped to the welding machine by means of T-slot bolts which pass through the holes in the ends of plates *C* and *c*.

Universal Self-Aligning Two-Hole Piercing Die

By WALTER WELLS, Newark, N. J.

A die with built-in quick-setting features designed for use in performing numerous piercing operations that ordinarily require individual dies, is shown in the accompanying illustration. In many types of light press work, such as required in making parts for experimental radio, electrical, novelty,



Figs. 1 to 4. Universal Self-aligning Two-hole Piercing Die, Showing Section through Punches and Construction of Adjustable Punch Member

or vending machine products, it is necessary to pierce screw or rivet holes in pairs. It is seldom advisable to attach parts with one screw, and in many cases the use of more than two screws increases the cost unnecessarily; thus the piercing of two holes is common practice.

In the case of pieces made in lots of 100,000, the pairs of holes would be pierced by a progressive die in conjunction with the blanking operation or a separate die would be used. When comparatively small lots are required, however, it hardly pays to tool up extensively, especially in cases where the dies are likely to become obsolete in a short time. Attempts to turn out short-run piercing jobs with makeshift single punch-and-die set-ups are usually unsuccessful. To pierce two holes with such equipment, the pieces must be run through the die twice; and since the blanks are usually gaged from the ends, the center-to-center distances are likely to be inaccurate.

In one shop, this problem was solved by making a two-hole piercing die that could be used for holes at any center distance up to 4 inches and for all standard holes in a universal range of blank sizes and forms. Figs. 1 and 2 show the two-hole self-aligning die. The main features are the work-locating fixture; the two-way adjustable die with an auxiliary quick-setting arrangement (a built-in scale); a two-way adjustable punch, shown in Figs. 3 and 4; and a single-unit self-adjusting spring stripper *F*.

The work-locating fixture is composed of the following parts: The baseplate *J;* the work-locating plate *A* having elongated slots for adjustable attachment to plate *J;* the removable parallel links *B*, shown in dotted lines; and the parallel slide *C* which is flush with the top of the plate.

Links *B* are connected to plate *A* and slide *C* by ground pins, and are removed after plate *A* has been adjusted to locate the work in the proper position over the piercing holes in the die. There are two sets of links *B*, each covering about half of the range of adjustment. The steel rules soldered in grooves in plate *J* are used in setting both the holder *D* and plate *A*.

The adjustable die-bushing holder *D* is held in place by an eccentric clamp *E*, and is removable for easy insertion of the die bushing *K* in either of the two bushing seats. Each bushing seat is intended to take care of about half the range of the center distance adjustment. Set-screws located at an angle of 45 degrees, hold the die bushings. The stationary die bushing *L* is held by a set-screw that is reached through a hole drilled from the front of the die to the slide channel.

To set up the die, locating plate *A* should first be adjusted to suit the work, using the two-way built-in rules and the paralleling links *B* for all symmetrical blanks, such as oblongs, elongated ovals, hexagons, etc. Irregular blanks can be held by attaching a special arm and disk to the baseplate. With the locating plate adjusted, the proper die bushings *K* and *L* are set in place, the die-holder being adjusted and set to the center-to-center distance specified for the holes by means of the scale. The punches are set last. The setting is done with the die mounted in the press, the adjustable punch being located from the die. For very close work, it is advisable to take a micrometer reading between the punches for accurately locating the center distance. The punches are made from 7/16-inch round stock, their ends being machined to the punch sizes required. The punch-holder is lined up with the die-holder and is mounted on the upper member of the set by a dovetail fit, as shown in Fig. 4.

The spring-actuated stripper unit is detachable to facilitate removal and resetting of the punches. The individual stripper plungers are retained vertically by a tongue-and-groove design, as shown in Fig. 4, and slide freely in the groove to accommodate any setting of the punch. The flats *G*, Fig. 3, permit very close spacing on minimum-sized blanks. There are two sets of stripper plungers, one pair being suitable for very small-sized punches. The stripping unit is snapped into place by means of the pilot-pin and spring latch arrangement shown at *H*, Fig. 4, and is then secured by means of cap-screws.

A quick-acting wrench is kept in a handy kit, along with the set of dies, punches, links, bars, plungers, Allen wrenches, etc. Also, a quantity of rubber-tipped wood dowel-rods are made up for use in holding the blanks in place against the two-way gage plate when operating the press.

* * *

Exports of Industrial Machinery

The exports of industrial machinery from the United States in December totaled $29,350,000, one of the highest monthly figures ever recorded and 21 per cent above the December shipments in 1938. According to the Machinery Division of the Department of Commerce, practically all major types of equipment participated in the up swing.

The exports of power-driven metal-working equipment reached the record monthly figure of $12,821,000 in December, 1939, which was 30 per cent more than in December the year before. For the entire year of 1939, the shipments of power-driven metal-working equipment totaled $112,570,000, the highest annual foreign sales ever recorded—a 16 per cent increase over the previous peak figure of $97,270,000 for 1938. Industrial machinery of all kinds was exported to a value of $289,863,000 in 1939—4 per cent more than the former record figure of 1929 and 7 per cent above 1938.

* * *

In 1870, agriculture alone gave employment to nearly one-half of the gainfully employed workers of the country, whereas, at present, considerably less than 25 per cent of the gainfully employed workers are doing farm work. Manufacturing employs close to 30 per cent.

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

A. C. H.—In a high-speed grinding mill, the stators are made of Ni-Resist castings in order to withstand the severe corrosive action encountered. There is an inserted alloy-steel ring in the stator which has to resist abrasive wear. We would prefer to use a cast material, if possible, for this service. Would Ni-Hard be a satisfactory material for an application of this kind?

Answered by Editor, "Nickel Cast Iron News" International Nickel Co., Inc., New York City

If the ring is not subjected to excessive vibration or deformation, it is quite possible that Ni-Hard would serve your purpose. It must be remembered, however, that this alloy iron is very hard and unmachinable, so that if the surface of the ring requires finishing, it must be done by grinding. If the demand is simply for a material to resist abrasive wear without impact or complex stresses, Ni-Hard would fill your needs well; but if toughness is a requirement, we would not recommend its substitution for the alloy steel you are now using.

Bonus Payment to Discharged Employes

G. V.—When a company promises bonuses to employes, is it compelled to pay the bonus in the event that the employe is discharged? Must the employer pay the bonus if unexpected poor business is encountered?

Answered by Leo T. Parker, Attorney-at-Law Cincinnati, Ohio

Generally speaking, if an employe accepts employment with the understanding that he may receive a bonus at the end of each year, he is not entitled to payment of the bonus if he is discharged before the end of the year.

For example, in Muir v. Leonard Co., [257, N.W. 723], it was disclosed that an employe, when accepting employment, filled out and signed a form entitled "Confidential Schedule," which contained information supplied by him as to his past history, and contained a clause: "All persons appointed to positions in this organization are on trial, and if at any time it is found that the employes are not adapted to the work to which they have been assigned, or not likely to prove useful, the engagement may be terminated without further reason, and without prejudice to the employes' reputation, the corporation's obligation ending with the payment of salary through the last day of employment."

A bonus memorandum was signed by both parties stating that "For the year ending September 30 your [employe's] bonus will be on the following basis [here explained] and be paid to you in addition to your salary . . ." Before the end of the year, the employe was discharged. He sued to recover the bonus. However, the Court held that the employe was not entitled to receive the bonus. On the other hand, the employer cannot break his contract to pay a bonus simply because business is poor.

Should Belts be Cleaned with Steam?

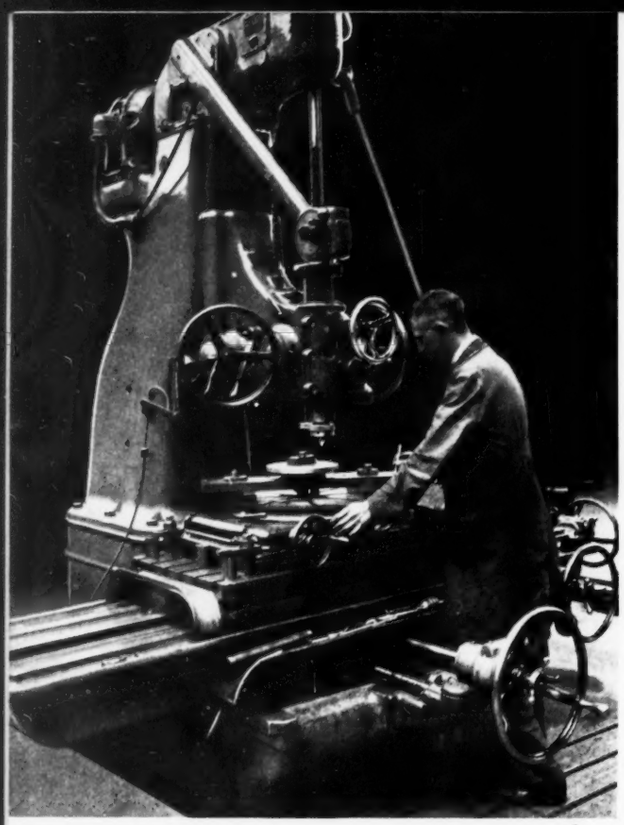
C. C. A.—I have seen belts being cleaned with steam, but have been told that steam is not a good medium for cleaning belts. Kindly give me some information on this subject.

Answered by W. F. Schaphorst, Newark, N. J.

Caution must be exercised in the use of steam for cleaning belting of any kind. Steam is an excellent cleanser for many purposes, but most kinds of belting cannot withstand its high temperatures. The temperature of steam at atmospheric pressure is 212 degrees F., and the higher the steam pressure, the higher the corresponding temperature.

A temperature of 212 degrees F. is too hot for most rubber belting. One prominent rubber belt manufacturer states that his belting is not affected by heat up to a temperature of 200 degrees F., but if higher temperatures are to be encountered, he should first be consulted. Balata belting is more sensitive to high temperatures than rubber belting. Its temperature should be kept down to less than 110 degrees F.

According to one well-known authority on the subject, oak-tanned leather belting should not be subjected to a temperature higher than 115 degrees F., which means, of course, that oak belting should never be cleaned with steam. It cannot stand it. Impregnated cotton belting should not be cleaned with steam, because steam is likely to wash out the impregnating compound without which cotton belting does not give satisfactory results. Stitched canvas belting should not be used in temperatures higher than 140 degrees F. Thus, it is obvious that few, if any, types of belts can be steam-cleaned with safety.

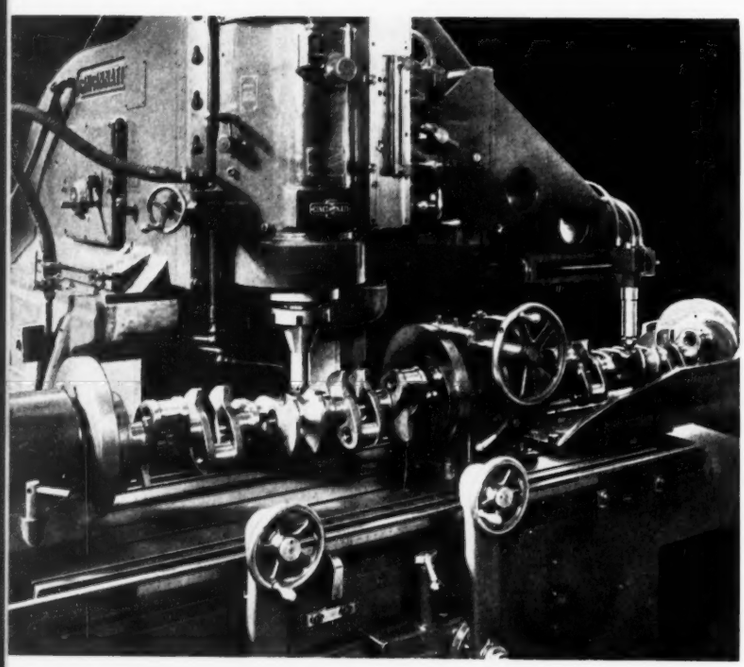


American Machines in

Second Installment of an Article Illustrating Some Applications of the Many American-Built Machine

OPERATIONS performed in the machine shops of England on some of the many machine tools shipped to that country by American manufacturers during recent years were described in an article in January MACHINERY. A considerable number of additional operations on American-built machines in English shops are dealt with here.

In Fig. 13 is shown a Pratt & Whitney jig boring machine, which is employed in the tool-room of the Standard Motor Co., Ltd., Coventry, to insure accuracy in the making of jigs and fixtures.



The edges of all cheeks on the crankshafts for a Rolls-Royce aircraft engine are milled to a 45-degree bevel in a Cincinnati Hydro-Tel milling machine arranged as shown in Fig. 14. The angular milling cutter in the vertical spindle of this machine is guided automatically around the changing contours of the crank cheeks as the spindle-carrier unit or cross-slide moves in and out and the spindle-carrier or vertical head moves up and down. These spindle movements are controlled automatically as a tracer on a bracket fastened to the right-hand side of the spindle head follows the cheeks on a master crankshaft held in a fixture at the right-hand end of the table.

This operation is completed on a crankshaft in approximately two hours, whereas when the edges of the cheeks were filed by the previous hand method, about twenty-seven hours was required for one crankshaft. All sliding units of the machine, that is, the cross-slide, the vertical head, and the table, are actuated hydraulically.

Each of the three bores in the airplane propeller hub barrel seen in the machine in Fig. 15 is ground

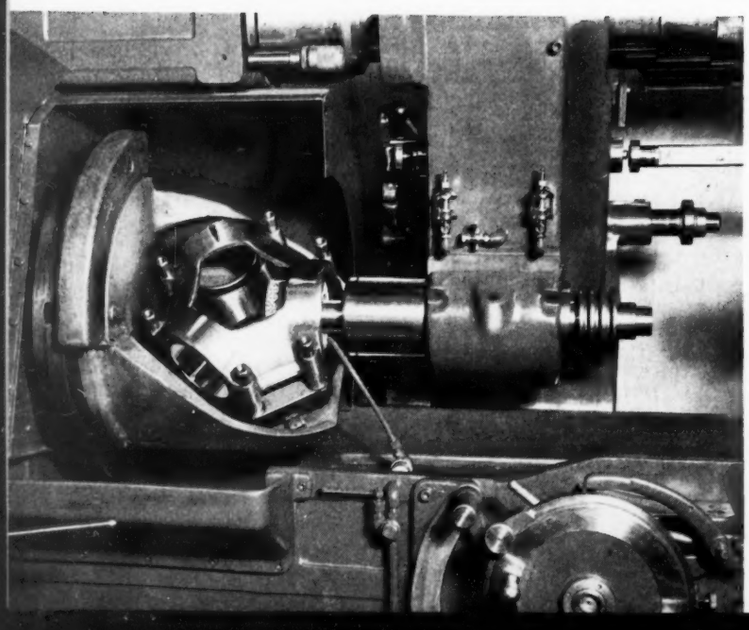


Fig. 13. (Top) Jig Boring Machine Installed in the Tool-room of the Standard Motor Co., Ltd., in Coventry, England

Fig. 14. (Center) Beveling the Edges of the Cheeks on Rolls-Royce Crankshafts in an Operation Controlled from a Master Crankshaft

Fig. 15. (Bottom) Employing an Internal Chucking Grinder for Finishing Three Bores, Faces, and Fillets in Propeller Hub Barrels for Use on English Aircraft

England's Busy Shops

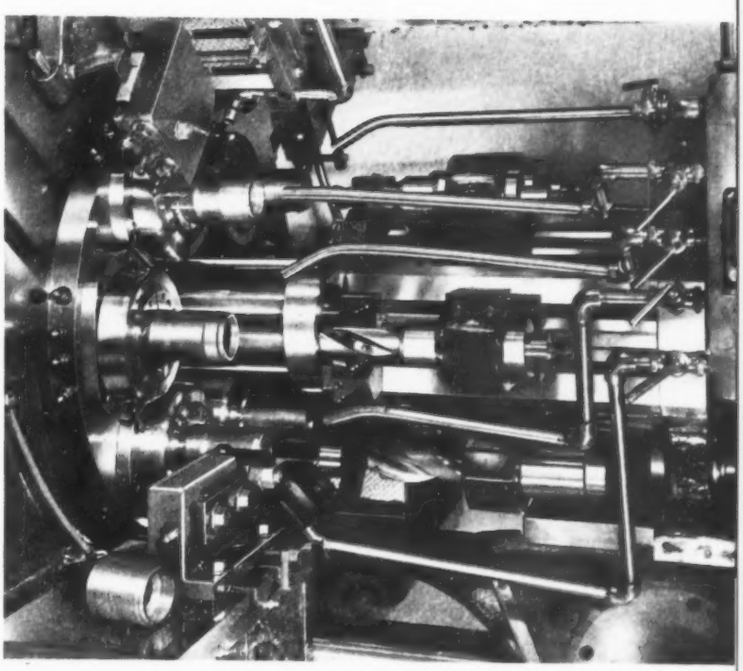
Tools and Other Metal-Working Equipment Shipped to the United Kingdom in the Last Year or Two

in the bore, on the internal face, and along a fillet on a Bryant internal chucking grinder. This operation is performed in a prominent airplane plant in England, and is completed at the rate of one part per hour. The propeller hub barrel is of heat-treated steel, and the dimensions of the surfaces ground must be held within a tolerance of plus or minus 0.001 inch. Approximately 0.025 inch of stock is removed from the various surfaces. The fixture is of an indexing design which enables each bore to be presented to the grinding spindle with one set-up of the work in the fixture.

American welding equipment in use in an English plant is illustrated in Fig. 16, which shows an operation involved in the fabrication of an arc-welded bedplate and frame for a large Diesel engine. Lincoln arc welders are employed to perform this and similar operations in the shop where the photograph was taken.

Seventeen separate operations are performed in thirty seconds of machine time by the Acme-Gridley six-spindle, 3 1/2-inch, bar automatic illustrated in Fig. 17, which is in action in an English automobile plant. This machine turns out clutch blanks, 2 3/4 inches outside diameter by 3 1/4 inches long, of the shape seen in the lower left-hand corner of the illustration. The material is hot-rolled free-cutting steel of S A E specification 5045.

An especially interesting grinding operation is shown in Fig. 18. This consists of finishing the three trunnions on an airscrew or propeller shaft by the application of a Landis Type C universal grinding machine, built for handling work up to 38 inches swing. This operation is being performed



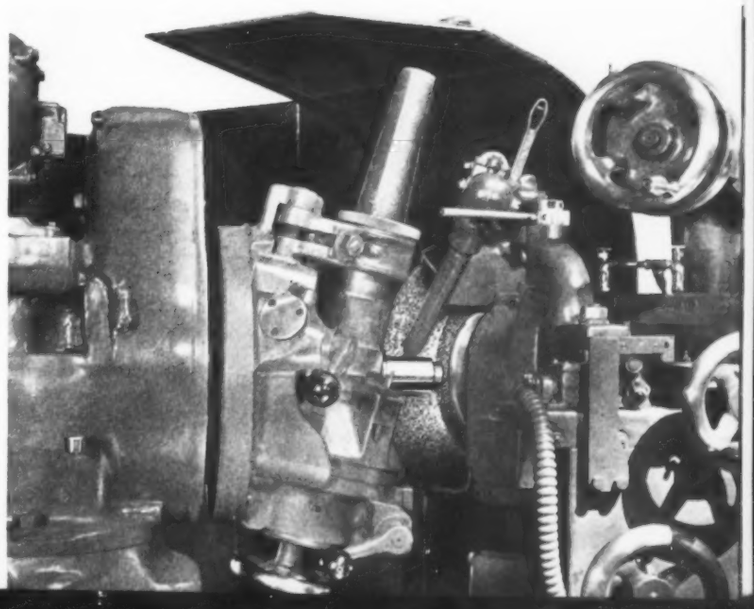


Fig. 16. (Top) Using Lincoln Arc-welding Equipment in an English Shop for Fabricating Diesel-engine Bedplates and Frames

Fig. 17. (Center) Seventeen Operations are Performed by This Machine within Thirty Seconds in the Production of Clutch Blanks

Fig. 18. (Bottom) Unique Method Employed in an English Aircraft Plant for Grinding All Three Trunnions of Propeller Shafts in One Operation

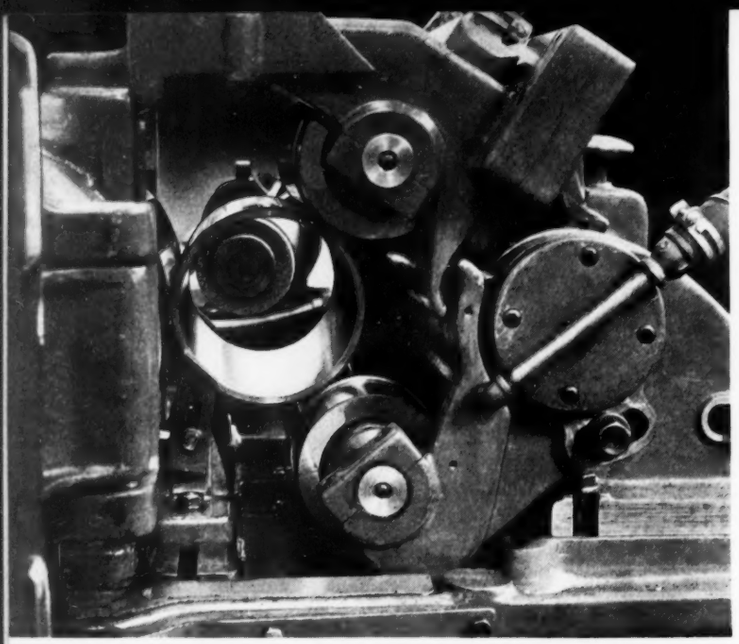


Fig. 19. Cylinder Sleeves for an English Airplane Engine are Ground Internally in a Centerless Type of Machine as Illustrated

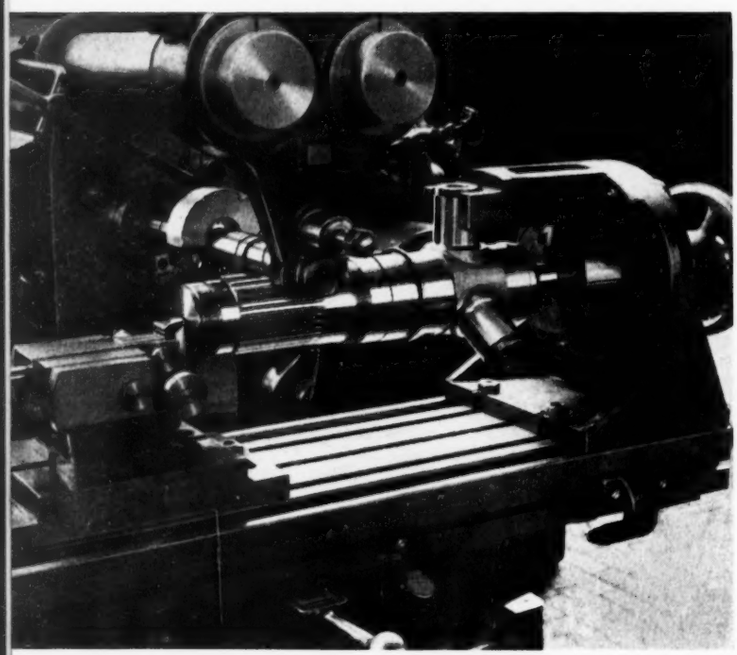
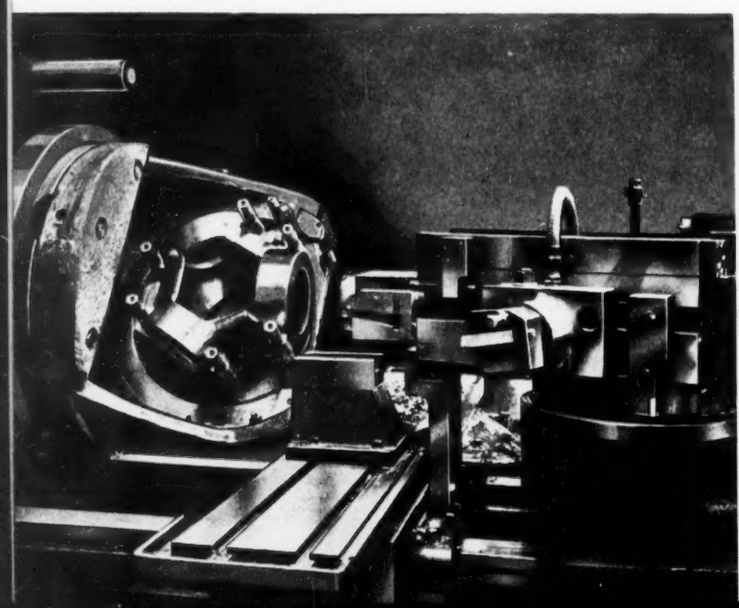


Fig. 20. (Above) Milling the Splines around a Propeller Shaft. Fig. 21. (Below) Potter & Johnston Automatic Machining Propeller-hub Forgings



in a prominent English plant. Grinding is accomplished by applying the side of a dish-shaped wheel to the revolving trunnions. The propeller shaft is held in a fixture attached to the nose of the live work-spindle. During grinding, the propeller shaft is clamped rigidly at two points. Full provision is made for locating and indexing.

The procedure is to grind one trunnion, unclamp the propeller shaft, index it through 120 degrees, reclamp it, and grind the second trunnion. At the end of this step, the propeller shaft is indexed through another 120 degrees for grinding the third trunnion.

A unique wheel-truing device, in the form of a compound slide, is used, so that the diamond can be both advanced toward the wheel and fed across the wheel face. As the accuracy of the fillet where each trunnion joins the main body of the propeller shaft is important, a means for radial truing of the grinding wheel is also supplied.

Cylinder sleeves and liners from 4 to 8 inches outside diameter and up to 16 inches long are ground on a Heald internal centerless grinding machine in an English airplane factory, as shown in Fig. 19. This view of the machine was taken with the camera directed toward the loading end, the grinding wheel being on the far side of the work.

The cylinder sleeves are both located and driven from the periphery by means of a regulating or drive roll, a pressure roll, and a support roll. The grinding wheel is passed back and forth through the revolving work to grind it to the desired diameter. An outstanding advantage of this operation is the ability to produce a close concentricity between the bore and the outside diameter. Sleeves of thin wall section can be accurately ground, and work can be rechucked without destroying the axial relation between the bore and the periphery.

The machine embodies a wheel-head construction by means of which an unusually fine finish can be produced. This consists of a wheel-head mounted at an angle on the cross-slide. The construction also enables the use of a much smaller grinding wheel than would be necessary with a conventional design.

The method employed for milling the splines on airplane propeller shafts at the Coventry plant of Alvis, Ltd., is illustrated in Fig. 20. This operation is performed on a Milwaukee horizontal milling machine, with one end of the shaft supported in a soft-jawed chuck and the other end by a center. Attached to the chuck is a dividing head that provides for accurate location of the propeller shaft in milling the successive splines. The splines are cut by a special form cutter, 3 inches in diameter, which is operated at a speed of 51 R.P.M., with a feed of 1 inch per minute. Three cuts are taken to finish each spline, stock to the depth of only 0.002 inch being removed in the final cut.

A number of Potter & Johnston automatics are used in turning out variable-pitch propeller parts at the deHavilland Aircraft Co., Ltd., Edgware.

Fig. 21 shows the first operation on the propeller-hub forgings or barrels, after the two halves have been bolted together, which consists of boring and facing the blade sockets. In this operation, the part is mounted in a carefully balanced indexing fixture provided with a swiveling plate to which the assembled work is fastened. The fixture can be readily indexed to bring either socket toward the turret tools and locked in the indexed positions.

The hole in the flange is first rough-bored and the flange faced by tools in a holder mounted on the first turret station, after which the outside and inside faces of the flange are roughed out by two tools mounted on an auxiliary slide on the second turret station. The third turret station is provided with another auxiliary slide which carries a tool that takes a second cut over the inner face of the flange and bores the sockets. Tools at the fourth station are also mounted on an auxiliary slide for forming and facing the flange. Finally, the inside face of the flange is finished and the socket bored with a tool.

In taking this cut, the turret feeds forward to pass the tool through the flange bore, and then remains stationary while the auxiliary slide is traversed in a guideway to feed the tool across the flange face. This motion is derived from the cross-slide by a lug on the turret face engaging a slot in the bracket on the cross-slide. When the tool has been fed the required depth, the cross-slide remains stationary while the turret-slide is traversed for boring the socket.

In producing the hub driving center for Rotol airscrews, the rough-turning is done in Warner & Swasey turret lathes, after which the parts are transferred to machines of the same make set up as illustrated in Fig. 22. The work is held in a special fixture which locates it from the bore. Five cuts are taken, including facing, boring, and recessing.

Brake-drums for English automobiles are being machined by the Gisholt Simplimatic lathe illustrated in Fig. 23, which is equipped with a Barker three-jaw air-operated chuck and a back facing attachment that may be seen between the chuck jaws. Tooling is provided for handling six different brake-drums.

The operation illustrated, which is the first performed on the drum, consists of straddle-facing, rough-boring, and chamfering by applying the back facing attachment; turning the rim with a tool on the front slide; facing the rim with a tool on the rear slide; and boring the brake surface and chamfering the corner with tools on the center slide. All together, there are ten tungsten-carbide tipped tools on the three slides and on the back facing attachment.

The feeds range from 0.010 to 0.029 inch per revolution of the work, while the peripheral speed is 165 feet per minute. The floor-to-floor time, for the particular operation illustrated, is 2.9 minutes.

Fine turning of aluminum-alloy pistons is accomplished in the Daimler plant in England by the

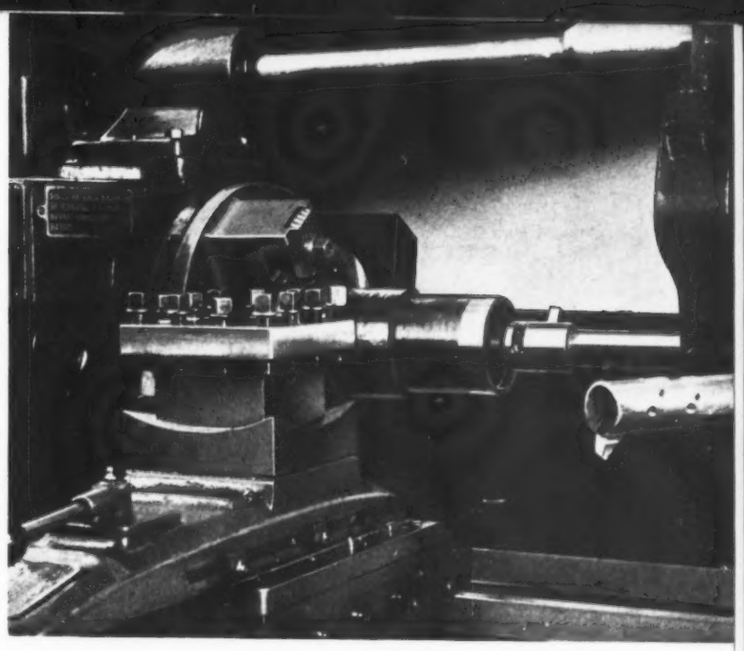


Fig. 22. Turret Lathe Operation in which Facing, Boring, and Recessing Cuts are Taken on the Hub Driving Center of Rotol Propellers

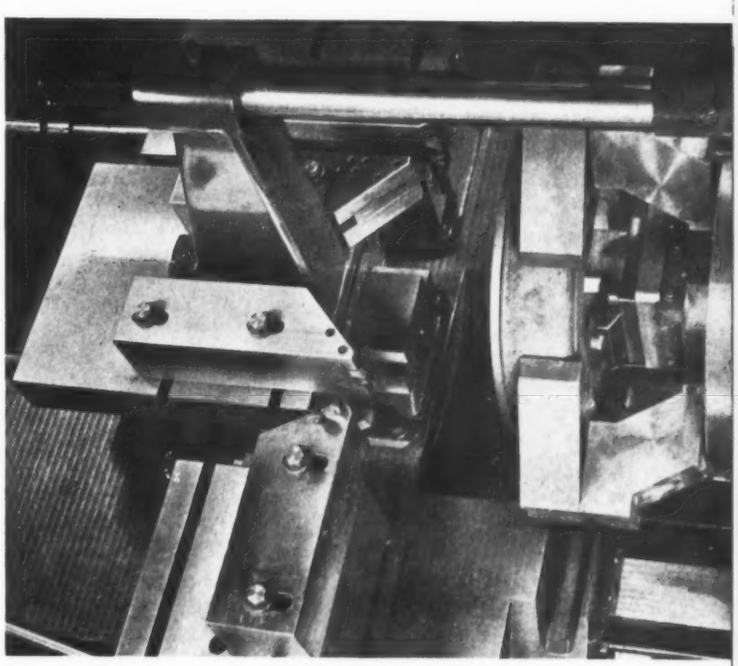
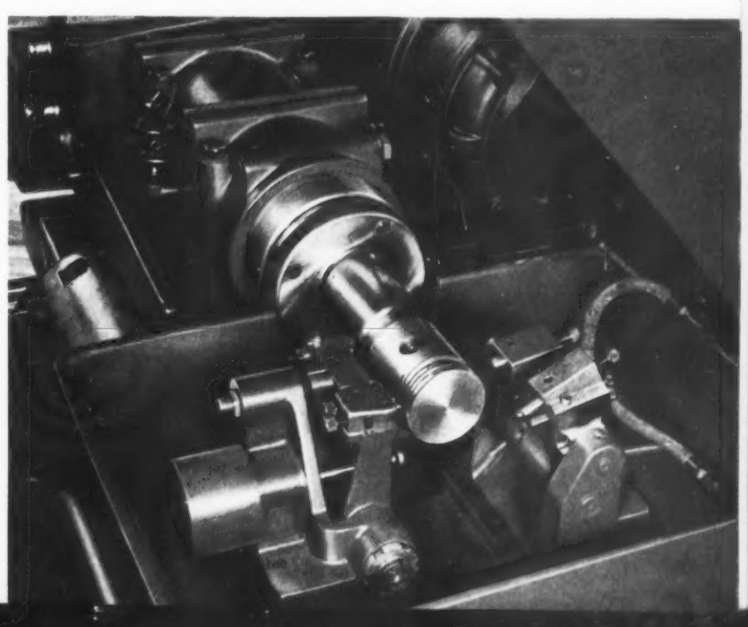
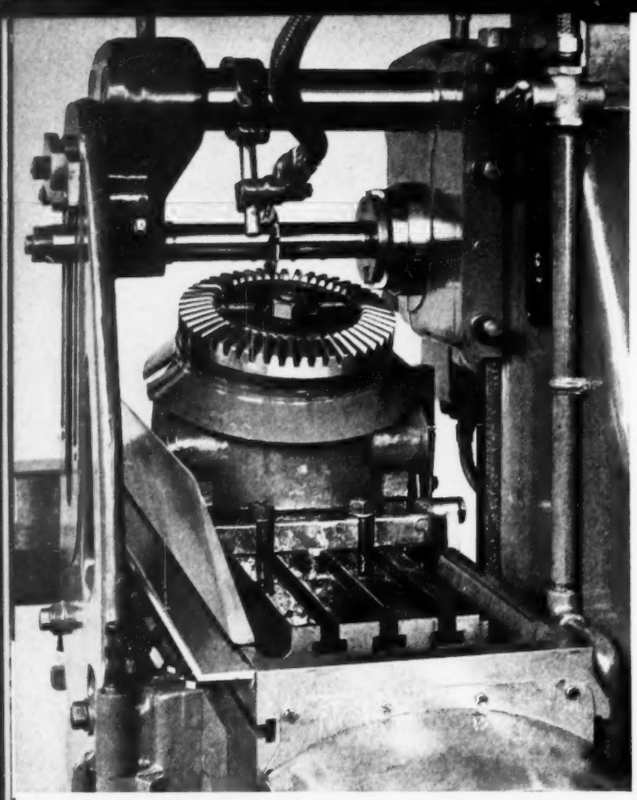
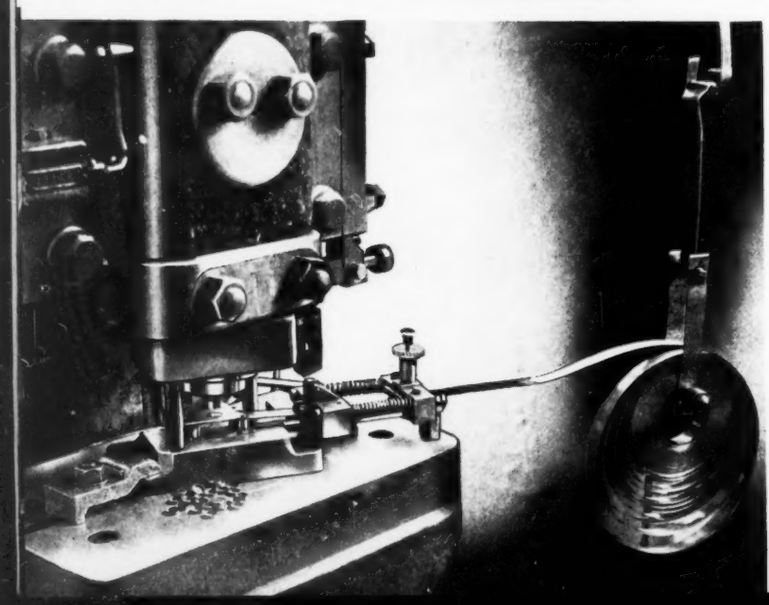


Fig. 23. (Above) Machining Automobile Brake-drums in a Simplimatic Lathe. Fig. 24. (Below) Precision-turning Skirt and Ring Lands of Aluminum Pistons







use of an Ex-Cell-O precision boring machine equipped as shown in Fig. 24. This operation consists of rough-, semi-finish-, and finish-turning the oval skirt and the ring lands. From 0.010 to 0.015 inch of stock on the diameter is removed in roughing, and from 0.004 to 0.005 inch in both semi-finishing and finishing. The length of the cut in roughing is 2 9/16 inches, and in finishing 2 3/8 inches, the maximum diameter turned being 2 23/32 inches.

The piston is located on a spindle adapter and clamped by means of a plug inserted through the wrist-pin hole and a draw-bar that extends through the spindle of the machine. In operation, the tools at the rear of the machine rough-turn the oval skirt and the ring lands while the table feeds from right to left. The tools at the front of the machine are then applied to semi-finish and finish the skirt as the table makes a return stroke from left to right. The swinging guard which covers the work during operation automatically shuts off the coolant when it is lifted. The production averages thirty pistons per hour.

The cutting of bevel gears in an English shop is being expedited, as shown in Fig. 25, through the application of an automatic air-operated indexing fixture on a Brown & Sharpe No. 12 plain milling machine. This operation consists of rough-cutting the bevel gear teeth with a circular cutter 3 1/2 inches in diameter which runs at a cutting speed of 87 feet per minute. The feed is 0.042 inch per revolution, and with the teeth 3 inches face width, the cutting time is 45 seconds per tooth, or one and one-half gears per hour.

At the end of each operation—that is, when the work has made a complete revolution past the cutter—the table is automatically moved to the loading position at a fast rate of travel.

In making the many dies required for the production of sheet-steel telephone parts in the press shop in the Coventry plant of the General Electric Co., Ltd., extensive use is made of the Doall contour sawing, filing, and polishing machine shown in Fig. 26. A magnifying glass attached to the machine provides an enlarged view of the intricate work being performed, so that the operator can readily guide the work along the saw in accordance with scribed lines.

Fig. 25. (Top) Milling Machine Equipped with an Air-operated Automatically Indexed Fixture to Facilitate Roughing of Bevel Gears

Fig. 26. (Center) Sawing and Filing Machine Used in Machining Contours of Die Members Employed in the Production of Sheet-metal Telephone Parts

Fig. 27. (Bottom) Ferracute Press Employed for Producing the Inner Shells of Operating Keys for Imperial Typewriters

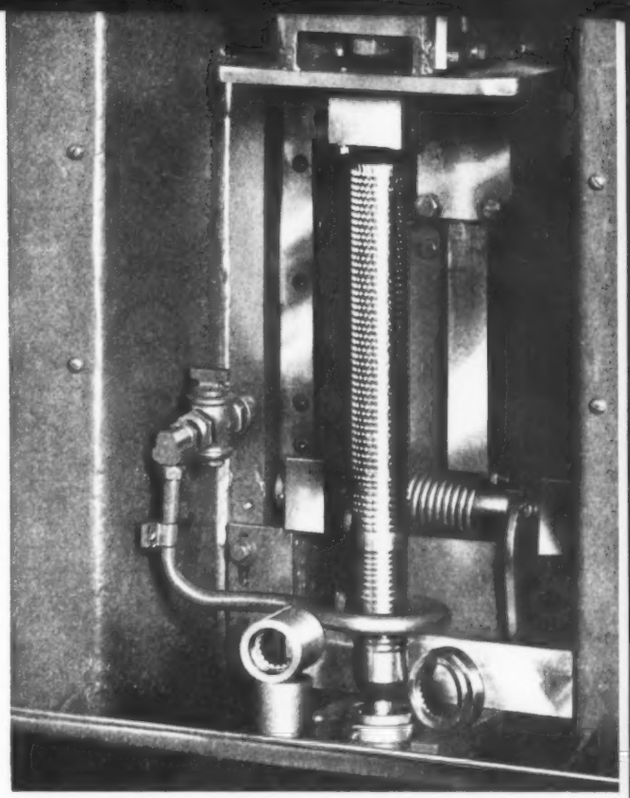
An interesting press operation in the shop of the Imperial Typewriter Co., Ltd., Leicester, consists of producing the inner shells of the typewriter operating keys from strip stock. This operation, which is shown in Fig. 27, is performed on a Ferracute press that operates automatically. A simple blanking, drawing, and piercing die is employed in combination with a mechanism on the press bed that feeds the stock forward the required amount for the successive operations during each return stroke of the ram. A jet of air is discharged across the die to eject the pieces as they are produced. The production rate is 5000 shells per hour.

Spiral splines are broached in transmission gears in the Vauxhall automotive plant in England by the Oilgear Cyclematic broaching machine shown in Fig. 28. First-speed and reverse gears are broached with twenty-nine splines, of 12 pitch, 28.588 inches lead, a pitch pressure angle of 27 degrees 30 minutes and a helix angle of 15 degrees 24 minutes. Second- and third-speed clutch sleeves are broached with eighteen splines of 12 pitch, 28.588 inches lead, a pressure angle of 27 degrees 30 minutes and a helix angle of 9 degrees 29 minutes. The broaches must, of course, be changed to suit the two types of splines.

Broaching one part at a time, a production rate of 180 pieces an hour is obtained. The part is supported on a faceplate equipped with a thrust bearing so that the part can revolve and follow the lead of the broach teeth as the machine table and the work are lifted upward along the broach.

The Black & Decker machine shown in Fig. 29 is employed to grind the seats of stem type valves for Armstrong Siddeley airplane engines. The work-head, which is equipped with a collet to grip the valve-stem, is positioned at an angle of 45 degrees relative to the spindle of the grinding wheel. By the operation of two handwheels, the work is fed both toward the wheel and across it as required. The work is rotated at 250 R.P.M.

Twenty-one surfaces are finished in a crankcase rear cover by means of the Heald Bore-Matic shown in Fig. 30, which is in operation in a prominent English airplane factory. Four boring heads are used, two on each bridge. The front left head performs the initial operation. It finishes a hole 3.5448 inches in diameter, chamfers this hole,



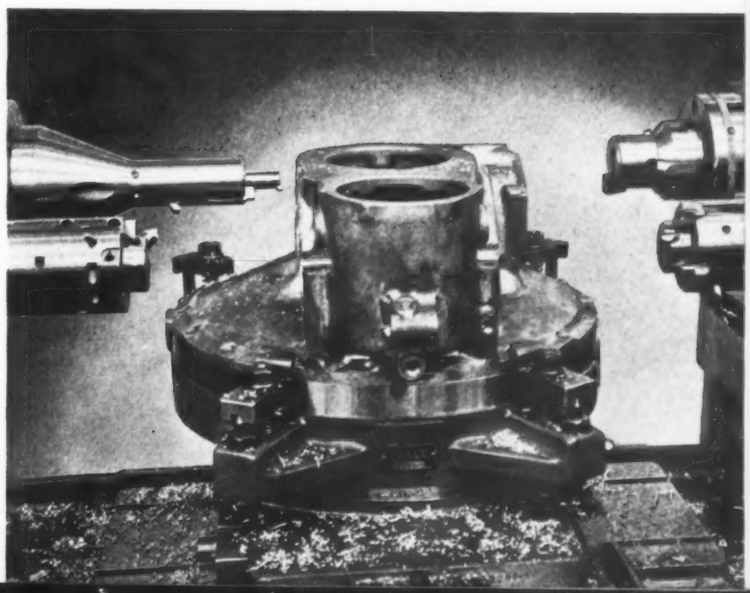


Fig. 28. (Top) Helical Spline Broaching Operation being Performed in an English Automobile Plant

Fig. 29. (Center) Machine Used for Grinding the Seat on the Heads of the Stem Type Valves Used in Armstrong Siddeley Airplane Engines

Fig. 30. (Bottom) Precision-finishing Twenty-one Surfaces in Crankcase Rear Covers for British Airplane Engines

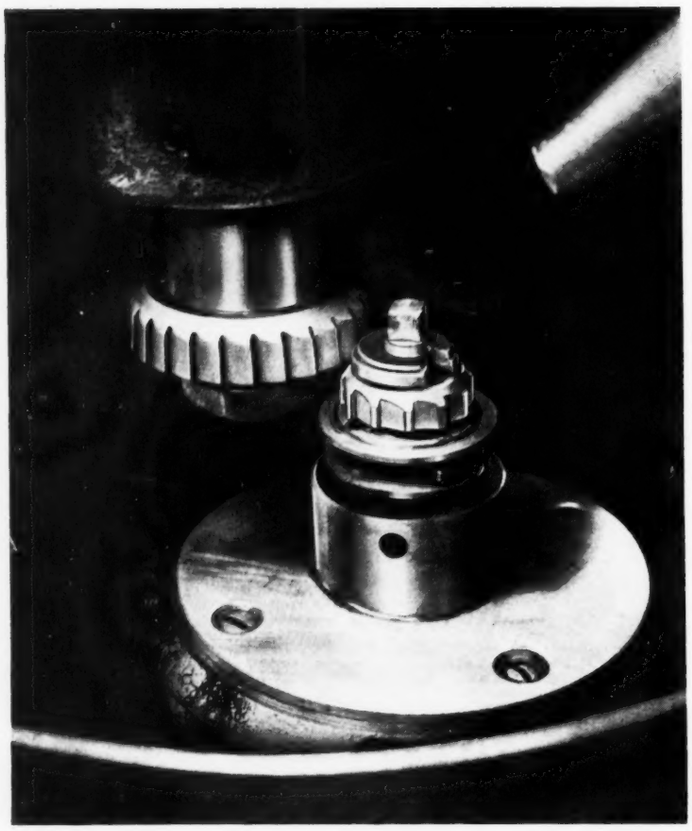


Fig. 31. Cutting a Ratchet Gear for the Combined Free-wheeling Units and Brakes Used on an English Bicycle

bores and chamfers a 2.189-inch hole in line with the first hole, and faces an external surface adjacent to the smaller hole. The table is then reversed and the front right head finishes a duplicate set of surfaces in the other end of the crankcase cover.

The table is next returned to the central position and the fixture indexed to the rear of the machine. A hole 2.6016 inches in diameter is then bored and chamfered, and a 0.950-inch hole is bored, chamfered, and faced, all of these cuts being taken by the rear left-hand head. The table is then operated toward the right, so that the rear right-hand head can form two chamfers, bore a hole 2.8448 inches in diameter, and finish a radius and face at the bottom of the bore. This completes the cycle.

The same machine is also used for precision-boring three more holes in the crankcase cover, the only changes necessary being the substitution of a different fixture, quills, and tools. These crankcase covers are made of magnesium.

A ratchet gear of the shape seen being cut in Fig. 31 is incorporated in the combined free-wheeling units and brakes used on a British bicycle. The operation illustrated is performed on a Fellows 7 type high-speed gear shaper. This machine is especially adapted for cutting a large number of gears of one particular size, but by using different work-holding fixtures, it can be applied to special needs. It has a short cutter travel, a high cutting speed, and a fine cutter feed. This machine operates on the generating principle, the same as other Fellows gear shapers.

The crank bore of automobile cylinder blocks is bored in an English plant by means of the W. F. & John Barnes machine shown in Fig. 32, which also faces both sides of the rear crank bearing. Both sliding heads are actuated by means of a hydraulic cylinder located in the bed. The left-hand head carries a single precision boring spindle for producing the final finish in the crank bore. This spindle is provided with a handwheel for positioning the bar preparatory to entering and leaving the bushings.

The right-hand head is provided with one spindle and two bar locks for retracting the expanding tools used to face both sides of the rear crank bearings. Feed is provided in both directions. The machine cycle is so arranged that the boring of the crank hole and the facing of the rear main bearing occur alternately. The production of this machine is twenty-eight cylinder blocks hourly.

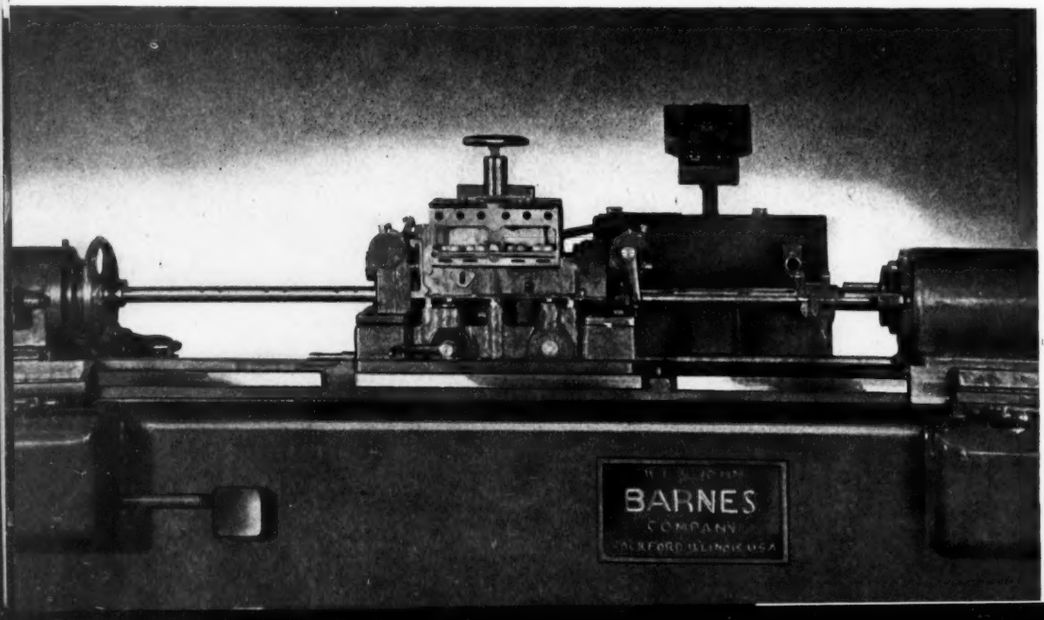


Fig. 32. Machine Used in English Automotive Plant for Boring and Facing Cylinder Blocks

Pluramelt—A New Steel Making Process

A New Method of Making Steel, Announced by the Allegheny Ludlum Steel Corporation, Resulting in a Low-Cost Material Covered or Clad with Stainless Steel or Other High-Grade Materials

MANY attempts have been made within recent years to combine the newer, expensive stainless steels with the cheaper carbon steels in order to decrease costs in certain applications. The chemical, petroleum, food and beverage, and paper industries, for instance, all require pressure vessels of great strength which, at the same time, will resist the action of corrosive liquids or gases. The high pressures frequently demand wall thicknesses of 2 inches or more; yet only the inner surface need be of the expensive corrosion-resistant material. It would be needlessly costly to make such pressure vessels of solid stainless steel when a thin layer of stainless material covering medium carbon steel would serve just as well.

Considerable progress has been made and many difficulties have been overcome in the production of stainless-clad materials. Various methods have been developed from time to time, all of which have had a measure of success. A new steel making process, which has just been announced by the Allegheny Ludlum Steel Corporation, is another step in the direction of obtaining a satisfactory combination of materials at a reasonable cost. With this process, it is possible to produce a single ingot consisting of a low-cost base metal as the chief material and a corrosion-resistant coating of stainless steel or a covering of some other metal. This method is not new in the sense that it is experimental, since pressure vessels made from metal produced by the new process have been in actual service in the oil refining industry for over two years.

Principle Involved in the Process

Robert K. Hopkins, director of metallurgical research for the M. W. Kellogg Co., Jersey City, N. J., was convinced that in order to obtain a material that would fulfill all the requirements of the petroleum industry for pressure vessels such as made by the Kellogg company, it would be necessary to depart radically from all previously used methods. He believed that the desired results could be accomplished only by a new method of melting the metals concerned. He concluded that a clad material might be produced if both components were molten, at least in part, at the same time, in order to secure absolute metallic homogeneity. This process, which may be described as "plural melting" has been termed "Pluramelt."

The results desired are accomplished by means of a special electric arc melting furnace, in which, briefly, all the special-composition material and the surface of the low-cost material are melted and integrally joined as part of the operation. The furnace is radically different from the conventional type of electric furnace in that the functions of steel making and of ingot mold are combined to produce Pluramelt ingots.

The research staff of the Allegheny Ludlum Steel Corporation was consulted in connection with the problems involved, and as a result, the steel company decided to participate in the development of the method. This work has culminated in the construction of a plant at Brackenridge, Pa., which is now in commercial operation under exclusive license from the Kellogg company under the Hopkins patents.

Alloys Other than Stainless Steel Can be Used for Coatings

Experience so far has been limited to stainless-steel alloys applied to soft or medium carbon steel, and to tool steels applied to soft steel base material, but it appears certain that commercial success with these materials may be duplicated with any other alloys that can be melted in an arc furnace. Present knowledge of the subject indicates that high-carbon steel can be added to mild steel, and that hard alloys or tool steels employed for wear resistance can be applied to rails, roll cylinders, or wheel treads. Hard nickel alloys can be similarly applied. The base metal can be covered on one or both sides, and the coating applied to any desired thickness. Ingots have also been produced with three compositions of materials integrally joined. Ingots have been rolled into plates and sheets down to No. 24 gage. Wire has also been produced by the Pluramelt process.

Strength and Uniformity of Composition Metal

Tests indicate that the composition material is as inseparable as if it were a unit mass. The principal requirements of any clad material are (a) that the joint between the base and surface layer should be flawless; (b) that the composition in both base and surface layers should remain uniform and accurate; and (c) that the fabrication should be easy and commercially applicable.

Many physical tests have been made to show the extreme tenacity between the materials joined. In bending tests, for example, where the elongation of

the outer fibers on bent bars has been 45 per cent, there has been no sign of parting of the materials or any other failure. In tension tests, the composition material and the low-cost material deform together, both compositions reducing in area without parting. In punching tests, no separation of the alloy from the base metal has been experienced. In compression tests, square blocks have been squeezed vertically until the sides collapsed without showing any signs of parting between the composition materials. Square bars have been twisted cold, two complete twists being made without cracking or separation.

The uniformity of the composition of the joined metals is obviously a matter of extreme importance. Tests made indicate that in this respect the process gives entirely satisfactory results. Tests have also shown that the alloy portion of the composition metal has a corrosion rate practically identical to a similar alloy composition made by the conventional electric furnace process. This has also been borne out by results in service.

The material made by the new process can be fabricated with existing shop equipment and lends itself well to being handled by present shop practice and methods.

* * *

Periodic Checking up of Cutting Oils

By W. F. SCHAPHORST

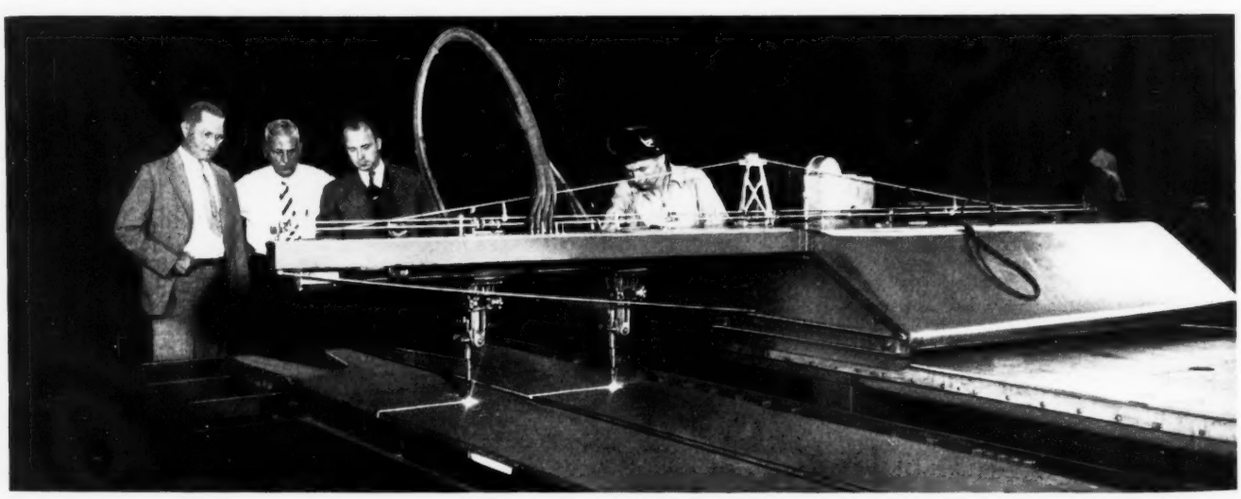
Cutting oils are often used in the shop year after year without any comparative tests being made to ascertain whether the oil being used is the most suitable or economical one for the purpose. The oil being used seems to do its work all right; it "gets by," and those in charge are satisfied. They do not want to make a change on account of the trouble that may be involved in switching from one oil to another.

During recent years, however, important advances have been made in all branches of machine shop operation, and such advances have extended to cutting oils or coolants. For that reason, when no change in cutting fluids has been made for some time, it should be worth while noting that in many plants metal cutting is now being done better and at less cost than formerly by the use of improved cutting oils. A test now and then is well worth while to determine whether some improved cutting fluid might prove more satisfactory than the one being used.

In making such tests, there are a number of questions to which the investigator should find the answer in order to be able to make a fair comparison: (1) What is the cost per gallon of the present cutting fluid? (2) Is the present fluid used "straight" or is it mixed with water? (3) If it is not mixed with water, can it be so mixed, or can it be mixed with some other liquid? (4) What is the present annual cost of cutting oil? (5) What would be the total cost per year if a change were made? (6) Does the new cutting oil aid in producing (a) more work, or (b) better work? (7) Does the new oil improve the finish? (8) Would the use of the new oil eliminate any finishing operation now necessary? (9) What is the appearance of the chips with the present oil —do they turn blue? Do they burn? (10) Does the present oil produce smoke around the machine? (11) Does the new oil improve the conditions listed under 9 and 10?

It is advisable every once in a while to check up on cutting oils and to make comparative tests. Without such tests, one never knows whether the best and most economical cutting oil is being used, or money wasted just because no one has taken the trouble to find out.

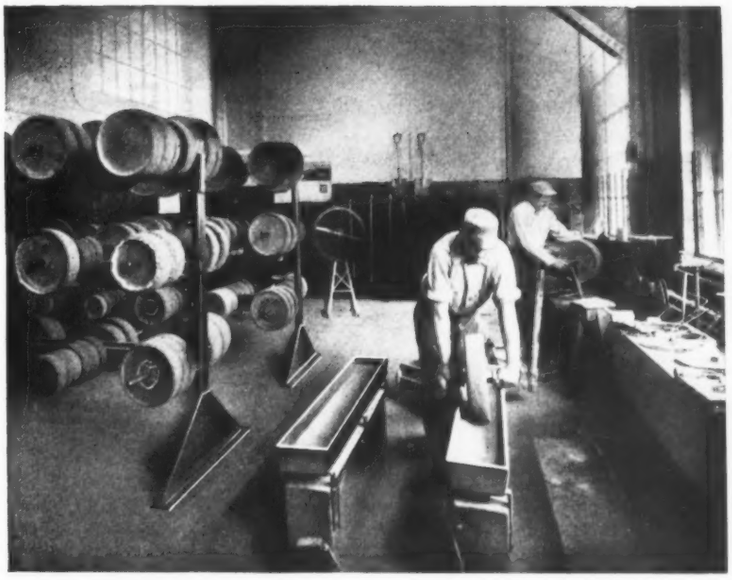
Automatic Flame-cutting Machine with Two Torches Controlled from a Master Templet on the Tracing Table. Photo Courtesy Link-Belt Co., Chicago, Ill.



Reducing the Cost of Polishing

Some of the Factors that Influence the Economical Performance of Polishing Operations, and Detailed Directions for Obtaining the Best Results

By HENRY R. POWER
Chief Chemist
The Carborundum Company
Niagara Falls, N. Y.



Room Equipped for the "Setting up" of Polishing Wheels

HIGH polishing costs are due not so much to incorrect methods of performing the actual operation as to the selection of the wrong polishing materials and to unsatisfactory practice in setting up the wheels. The two latter conditions account for most of the high costs in the setting-up room and low production and consequent high costs in the polishing room.

It is not uncommon to find shops in which the polishing cost is the largest item in the total cost of a metal product. Until recently, little study had been given to standardizing the materials used, the methods of setting up the wheels, or the methods of using the wheels. Yet, where this has been done, great economies have often resulted. In one case, the life of the wheels was increased 29 per cent, the cost of setting them up was reduced 40 per cent, and the total polishing cost was reduced 22 per cent.

It would take a good-sized book to describe in detail the best polishing procedure to use on each of the hundreds of different metals now finished by polishing, and such instructions would be subject to variation to meet specific shop conditions. It is, however, possible to give basic hints on selecting materials and setting up wheels which are universally applicable and will reduce total polishing costs in most shops. That is what this article is intended to accomplish.

Polishing involves the use of machines, wheels, glue, and abrasive. Most polishing machines are of the floor stand or bench type. However, for long runs, it pays to build automatic machines. Some very ingenious ones are in use in mass-production shops.

Polishing wheels are made of various fabrics and leathers, depending upon the material to be polished, the shape of the piece, the finish required, and whether the wheel will be used for roughing, dry fining, greasing, or finishing operations. The selection of the most effective and efficient wheel for a particular job calls for the advice of an engineer with wide polishing experience and, usually, careful tests under actual shop conditions. The following general considerations, however, will limit the number of wheels that need be tried out:

Wheels of woven cotton fabrics are most widely used. Metals to which they are well suited include iron, steel, brass, bronze, and aluminum.

For roughing cast iron and steel, and for dry fining on such parts as builders' hardware, canvas wheels are used.

Softer canvas wheels are used for polishing heavy castings of non-ferrous alloys, brass, copper, and aluminum. Quilted wheels of thin canvas are used for parts of irregular shape, such as stampings and castings.

Walrus-hide wheels give a fine finish, and are therefore used on firearms, cutlery, silverware and parts made of high-carbon steel where a very fine finish is often desired.

For very irregular shapes where fine finish is required, as in the automotive, airplane, and hardware industries, wheels of sheepskin or felt are used, due to the fact that their faces can readily be shaped to fit the surface.

Certain types of flat work, such as cutlery, call for a wheel with a thin cushion, backed by a solid core. Wooden wheels with a leather cover are suitable for such work.

Whichever type of wheel is selected, it is impregnated with abrasive, which is held to the wheel by glue. It is of great importance that the glue and abrasive be carefully selected for the particular operation, and applied in the proper manner. Only the best grade of hide glue should be used. It should be graded, by the viscosity test, at 115 millipoises or higher. Ground glue is easier to handle and more easily dissolved than flake glue.

Most polishing is done with artificial aluminum-oxide grain. Silicon carbide is used for certain polishing operations on glass and granite, and natural emery has applications for some metal polishing. Rouge and pumice are used for certain finishing operations. It is essential that the abrasive be of high quality; for instance, it should be of great uniformity as to size of grain. Over-size particles will scratch the surface of the piece, while if there is an excessive amount of under-size grains, production will be slowed up.

The production efficiency of the abrasive depends to a great extent upon the shape of the individual grains. Ordinary artificial aluminum oxide as it comes from the crusher contains some weak grains, thin "flats," and long, narrow "slivers." These should be removed by its maker, as they have little polishing value and thus slow up production.

To get the maximum production from a polishing wheel, it is essential that the abrasive grains be sharp; that means that the grains must be irregular in shape, with angular edges—not rounded or smooth. Unless the grains possess a high degree of capillarity, they will not be wet sufficiently by the glue and will tear out of the wheel face too readily. The capillarity should be permanent, that is, it should not be affected by exposure to the air.

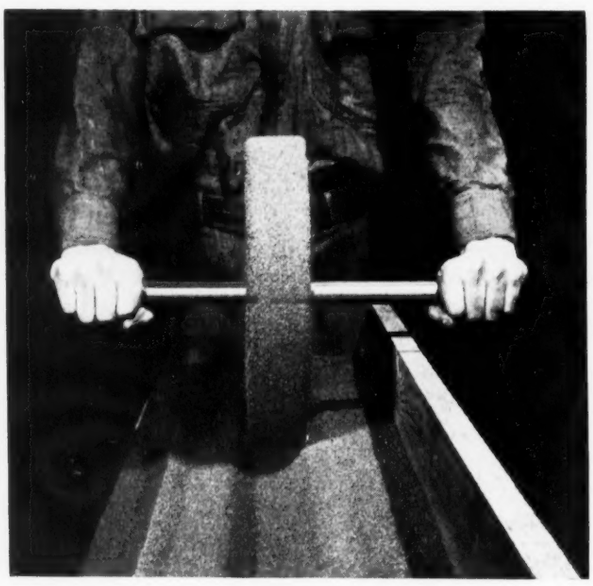
By etching the abrasive grains chemically, the glassy, slippery surfaces are changed to improve the capillarity and to develop a property known as "surface tenacity." It is possible to control this property so that the ratio of glue to abrasive on the wheel will be correct and the abrasive securely held to the wheel. This gives a wheel with an open coating, which has a definite clearance between grains. The result is less filling of the wheel with abraded material, less frequent dressing, and longer wheel life.

Polishing grain comes in various standard sizes from No. 10 to No. 220. The accompanying table gives approximate sizes for many common polishing jobs. These should be taken as suggestions rather than as absolute recommendations. Only actual tests under shop conditions can safely be relied upon to determine the exact size of grain that will give the best results for a given job.

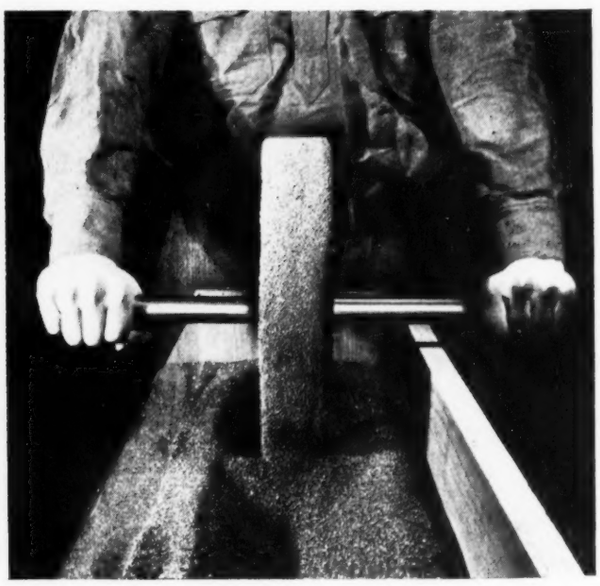
Preparation of the Glue

The efficiency and life of a polishing wheel depend to a great extent upon the preparation of the glue. It is essential, for instance, that the proportion of water to dry glue be correct. Tests show that for severe conditions, where the wheel comes in contact with rough corners and sharp edges, and abrasives of 24 to 36 grit are used, the proportion should be one part of water to one of glue.

For less severe work, consisting of plain surfaces with round corners, where 24 to 36 grit abrasive is used, ten parts of water to nine of glue is best. For similar work where grains of 36 to 54 grit are used, the proportion should be ten parts of water to eight parts of glue; and where the grit size is from 60 to 80 or finer, the proportion should be from ten of water to seven of glue to two of water to one of glue. These proportions are by weight. To measure the glue by volume is inaccurate, because the weight of a given volume varies according to the fineness of the glue.



Treated Grain Packs Properly under the Polishing Wheel when "Setting up"



Untreated Grain Slides away and Piles up Ahead of the Wheel as Shown

Somewhat less than the full amount of cold water should be added to the glue and the mixture allowed to stand for several hours, or even over night. Enough soaked glue for three or four hours' requirement is heated to 150 or 160 degrees F. in a water bath or in an electrically controlled dry bath. When the glue is completely dissolved, enough warm water is added to bring the mixture to the proper proportion of water and glue. Small quantities are prepared at a time, since glue that is kept hot for periods as long as a working day loses strength. Glue that gets hotter than 160 degrees F. also loses strength. Since destructive bacteria thrive in glue, it is necessary at the end of the day to clean the glue-pot and brush it thoroughly with hot water.

To prevent coarse and fine abrasive grains from becoming mixed, separate glue-pots are used for each grit size of wheel. Otherwise, small grits would be carried by the brush to the pot and transported by another brush to a wheel using coarse grit, and vice versa.

Coating the Wheels with Glue and Abrasive

Wheels are given a thin sizing coat of glue, a base coat of glue and fine abrasive (120 to 150 grit), and a final coat of glue and coarser abrasive. The sizing coat covers the face and sides. If the wheel has never been used, it is first trued on a lathe and marked with an arrow to show the direction of rotation, which should be the same for polishing as for truing.

If an old wheel is deeply pitted or covered with grease or oil, the old "head" should be completely soaked off with hot water. In cases where the sizing has been worn through, it should be resized with abrasive and thin glue. If the sizing is intact, the face and edges are trued with a silicon-carbide brick or a file. Oil or dirt on the wheel face should be removed with gasoline.

In applying the final coat of glue and abrasive, it is necessary to spread the glue uniformly over the face of the wheel, and prevent it from jelling. To this end, the wheels are heated to about 120 degrees F. in a warming closet, and the same area of wheel covered with each brushful of glue. The grain is kept in a trough at 120 degrees F., and the wet wheel rolled in it by hand with a moderate pressure or by a machine. To determine whether enough abrasive has been taken up by the glue, the wheel is rolled on a hard level surface. If some glue comes to the surface, the wheel should again be rolled in the trough of grain.

If the abrasive has been chemically treated to give it the proper surface, merely rolling the wheel in the trough will give the wheel the correct surface. However, if the abrasive grains have a shiny, slippery surface, it may be necessary to pound the wheel in the trough, which is undesirable. For some purposes, it is desirable to give the wheel a second coat in the same manner, after partially drying the first coat.

Importance of Proper Drying of the Coated Wheel

The drying process is very important. If insufficiently dried, the glue will remain in a jelly-like condition, the wheel will "load," and pieces of the face may tear out. On the other hand, if the wheel is over-dried, the abrasive grain will tear out easily and the wheel will have a short life.

For drying, or "curing" as it is sometimes called, the wheels should remain in a room, the temperature of which is close to, but not more than, 80 degrees F., with about 50 per cent relative humidity, for forty-eight hours. To maintain these conditions, a separate curing room is essential. The results will be poor and not uniform, if, as is so often done, the wheels are cured in the setting-up room.

Since the humidity increases rapidly when a fresh batch of wheels is put in the curing room, it is essential that some means of maintaining the proper humidity be used. A recording psychrometer, which gives both temperature and humidity, should be installed and closely watched. More uni-

Grit Size of Aluminum-Oxide Grain for Polishing Operations

(Recommended by The Carborundum Company)

Material or Parts to be Polished	Operation Number			
	1	2	3	4
Aluminum, die-cast	150	Buff		
Aluminum, sand-cast, inside	36–46			
Aluminum, sand-cast, outside	60–80	120–180	Buff	
Aluminum, sheet	120	180	Buff	
Automobile bumpers	60–90	120	150–180	220
Automobile fenders	90	120–150		
Automobile headlights	180–220	Buff		
Automobile hardware	36–54	90	120	220
Brass, sand cast	60–80	150–180	220–3F	
Brass, sheet	180–220	Buff		
Cutlery	80	120	Buff	
Flat irons, electric	60–80	120	150	180–240
Forks, hay	60–70	100–120		
Forks, spading	24			
Gray iron, not pickled	70	120–150		
Gray iron, pickled	80	120–150		
Hammers	46–60	100–120		
Hoes, best quality	36–46	70	100–120	
Hoes, second quality	36–46			
Knives, steel blades	80–90	120–150	220–F	Buff
Knives, backs	46–60			
Knives, machete, edges	46–60			
Knives, machete, faces	80	120		
Monel metal, cast	80	120	150	Buff
Monel metal, deep-drawn	120	150	180	Buff
Monel metal, full finish sheet	180	220	Buff	
Plowshares	36–46			
Plow disks	30–46	70–90		
Shovels, blades	36–46	120		
Shovels, straps	36–60			
Steel, sheets for enameling	90	120–150		
Steel, stainless, mirror finish	60–80	100–120	150	220–3F Buff
Steel, commercial finish	80	100	120	150
Wrenches	30–46	80	120	

form results will be achieved if the air is circulated artificially. Properly controlled temperature and humidity, together with adequate circulation of air, will greatly speed the curing process and produce better polishing wheels.

Decreased production in polishing is often blamed on wheels, abrasives, or glue, when the real trouble is in the setting-up or curing room. If all the processes and materials entering into the making of a polishing wheel are given close, intelligent study, it will often be possible to reduce polishing costs to a surprising extent.

* * *

Materials Artificially Aged by Salt Spray

In the constant search for better materials, especially for products subjected to outdoor exposure, the engineer must make many tests simulating actual operating conditions, but at a much accelerated rate. One of these is a salt-spray test, which indicates to an experienced observer the extent and rapidity of corrosion that may be expected when the material is exposed outdoors. Such a test will reproduce in a few days or weeks conditions that would be reached only after years of service.

At the Westinghouse Lighting Division at Cleveland, Ohio, such salt sprays are used to test the materials for lighting units. The salt-spray testing apparatus consists essentially of a pump supplying compressed air to a nozzle placed in a bath of salt water forming a cloud of salty vapor that is cooled in a tank that houses the materials under test. Compressed air is supplied to the nozzle by a small motor-driven pump at from 30 to 50 pounds per square inch pressure. The nozzle is similar in action to a paint spray gun. The stream of escaping air passes over the restricted opening of a tube extending up from the salt water bath, pulling the water through the tube and vaporizing it as it leaves the opening.

During operation, the tank is completely filled with a dense cloud of vapor. The tank is built with a hinged top but without air vents, thus allowing the vapor to escape only around the edges of the hinged top. This produces as nearly uniform a cloud inside the tank as it is possible to obtain and insures even corrosion of all parts of objects under test.

Sodium chloride (common table salt) is used for the salt solution. It is the best for testing materials used in general service. For some tests of marine applications, sea salt may give a more accurate result.

Many types of materials are tested. Paints, varnishes, and lacquers represent a large part of the work. These are sprayed, dipped, or brushed on flat test panels and dried. These panels are then supported vertically in the salt-spray tank, so that all parts of the panel have an equal exposure. The criterion in these tests is the length of time necessary for the paint to deteriorate and lose its finish or its value as a protective coat. Metals, particularly when plated, are also placed in the tank in the form of test panels. The criterion in this case is the loss in weight or the decrease in the thickness of the plating.

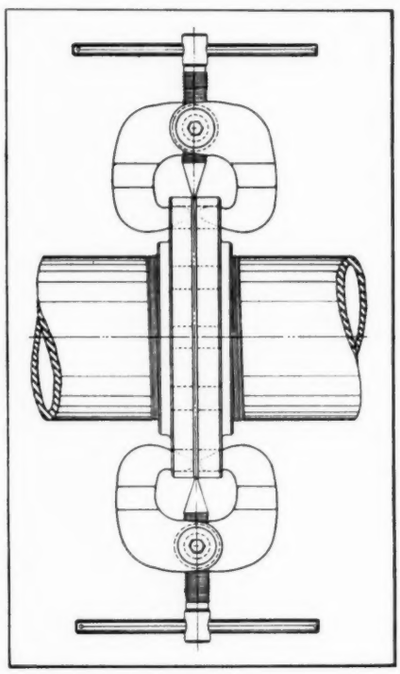
Whenever possible, materials are tested on flat panels that can be supported vertically in the tank. This leaves no horizontal or slanting surfaces on which the salt can deposit and provides a more accurate test. In the case of irregular objects, allowance must be made for the shape and position of the various surfaces. During a test, the salt spray is operated continuously from the start to the end. This means days, weeks, and sometimes months of continuous operation, and tells in the shortest possible time what may be expected of a material after years of service.

* * *

Flange Jacks for Use in Replacing Gaskets in Flanged Pipe

An ingenious tool, known as a flange jack, for use in replacing gaskets in flanged pipe lines is shown in the accompanying illustration. This jack has been developed by the Garlock Packing Co., Palmyra, N. Y., with the idea of providing a faster, safer and better means of replacing gaskets. In using the flange jacks, it is only necessary to remove two bolts on opposite sides of the flanges, place the jaws of the jacks in the bolt-holes as shown, and tighten up the screws in the positions indicated.

The screws in both jacks are turned down simultaneously, so that the flanges will separate evenly. The jack-screws and their points are, of course, kept well oiled. When a sufficient opening between the flanges has been obtained, the old gaskets are removed, the faces of the flanges cleaned and a new gasket inserted. The screws in both jacks are then backed off simultaneously, the jacks removed, and the bolts inserted in the flanges again.



Method of Separating Pipe Flanges with Jacks to Permit Replacing Gaskets

Using Microscopes to Facilitate Accurate Machine Work

By ARTHUR BAKER

The ordinary bench filing machine can be used to advantage much more frequently than it now is in filing dies, punches, templets, or in producing hand-made parts in a model shop. One of the reasons that these machines have not come into more general use is the difficulty experienced in filing up to a line quickly and easily. In order to see the lay-out line, especially in the dimly lighted locations assigned to some filing machines, it is necessary to have exceptional eyesight or else use a magnifier of some kind. It is not the object of this article to discuss lighting systems, but rather to suggest a better way of seeing the lay-out lines and filing to them.

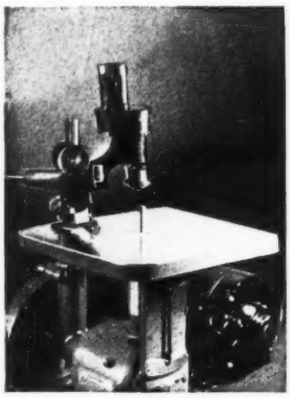


Fig. 1. Microscope Mounted on Bench Filing Machine

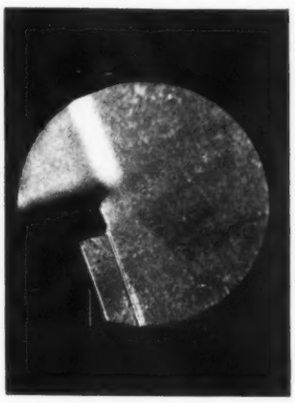


Fig. 2. Work and File as Seen through Microscope

The use of a low-powered microscope, preferably of the binocular type, is more satisfactory than wearing a magnifier, monocle fashion, or trying to hold a glass in one hand and work with the other. Microscopes can be obtained that will focus on the work and still have no part of the instrument close to the work. The one shown in Fig. 1 can be accurately focussed on the work without bringing any part of the instrument closer than 2 1/4 inches to the work.

The binocular type microscope shown in Fig. 1 was removed from its regular base, together with the rack and pinion used for focussing. A rod, the same size as that used in the hold-down fixture on the filing machine, and of convenient length, was welded to a flat piece of stock. The flat stock was then drilled and tapped for mounting the microscope in the same manner as on its regular base. With this arrangement, the microscope could be adjusted to any position above the table or swung out of the way when not in use. The lowest power combination of lenses is used with the microscope, as this increases the area of the work that can be seen and also lessens the blurring effect produced by vibration. It should be noted that the microscope can be used to the best advantage when the machine is securely fastened so as to reduce the amount of vibration.

The microscope makes a lay-out line appear like a groove made with a heavy cold chisel, so that it is possible to file the metal from the work up to and including the last finishing stroke of the file while both hands are free to manipulate the work.

Fig. 2 shows a photomicrograph of a fine scribed line and one corner of the upper end of the file. The file is out of focus in the illustration, being somewhat higher than the work. The scribed line, when viewed through the microscope, appears larger than in the accompanying illustration, as the camera has a somewhat reducing effect.

A microscope of the type shown in Fig. 1 can also be used to advantage on other machine tools. For example, it can be used on the vertical shaper, where a lay-out line often serves as a boundary, limiting the feed of the shaper tool. The jig borer and vertical milling machine are other machine tools on which the microscope can be employed with good results. When used properly on machines of this kind, the operator can see just what the tool will do before it is actually fed into the work. This prevents spoiling work and gives the operator confidence to go ahead with the machine work at a faster rate.

* * *

General Electric Employes Honored for Outstanding Achievements

Twenty-two employes of the General Electric Co., from eight different works and offices of the organization, have this year received the awards made by the Charles A. Coffin Foundation. The twenty-two awards were made for seventeen distinct accomplishments, four being made jointly to two or more individuals who cooperated in the work that brought them recognition. Eight of the men are classed as factory workers, twelve as engineers, and two as commercial men.

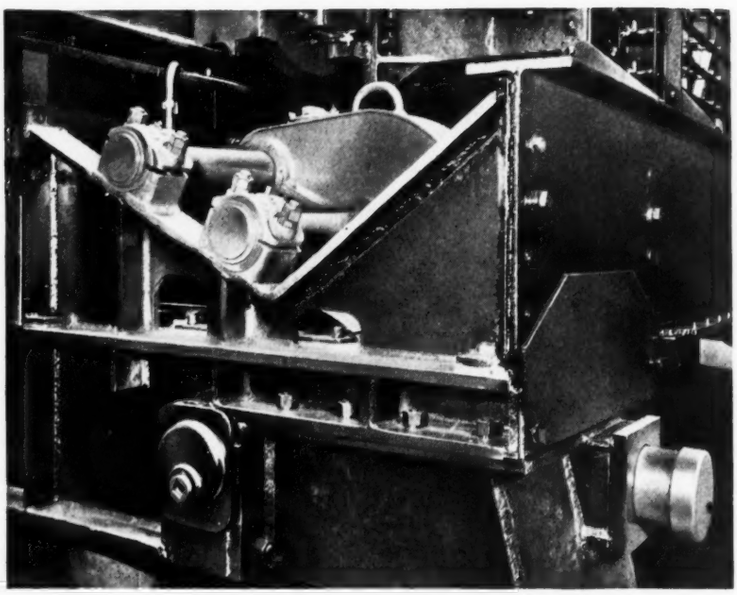
The awards were made for a great variety of accomplishments, ranging from methods of assembling turbine buckets in power houses without disassembling the machines to the development of a complicated engineering theory and its practical application. Included among the awards given in the engineering group was one for the development of high-voltage circuit-breakers for a high-speed camera which successfully takes 120,000 exposures a second, believed to be the highest rate ever attained in any kind of photographic work.

These awards have been made for the last seventeen years. At present, there are five hundred employes of the company who have received this award, the highest honor conferred by the company on its employes. Every one of the 70,000 employes of the General Electric Co. is eligible for an award.

Cast Frame Versus Welded Construction in Press Design—A Comment

Experience of the Wellman Engineering Co., Contrasted with Results Recorded in the Article "Changing from Welded to Cast Frame Construction in Press Design" Published in the January Number of MACHINERY

By A. E. GIBSON
President, Wellman Engineering Co.
Cleveland, Ohio
Past-President, American Welding Society



Part of a Welded 12-ton Capacity Open-hearth Charging Machine End-carriage, Believed to be the Largest Ever Built. Few Types of Steel Mill Equipment are Subjected to as Severe Service as Charging Machines. The Company Building This Guarantees the Welds against Failure for the Life of the Machine

THE article entitled "Changing from Welded to Cast Frame Construction in Press Design," published in January MACHINERY, page 159, was read with much interest, especially because in late years industry has become used to a reversal of the order of the methods of fabrication mentioned in the title. Much that has been printed and said before engineering gatherings on the subject of welding has been wishful thinking by men whose main objectives have been the furthering of their own interests. Much has been written and said with too little exact knowledge or experimentation to back it up. We have been prone to accept the results of a single test as representing what would transpire even under widely varying conditions.

This is why the writer was greatly interested in what has taken place at the E. W. Bliss Co. It is assumed that the author of the article speaks authoritatively for the company—a company that enjoys a high position in Industrial America. The writer of this comment on that article frankly admits that his thirty years of engineering and fabricating experience has had little connection with presses, and concedes that his experience in building car dumpers, ore unloaders, bridges, coke oven equipment, gas producers, etc., does not qualify him to speak with equal authority—or any authority for that matter—on press design. We will accept the Bliss decision as representing that company's experience, based on the company's own interest and that of its customers' too—those two considerations just have to go together.

These comments are made because the writer's experience has been so dissimilar, in meeting many quite similar problems in his company's products. We have solved many problems through welding, and solved them as we have never been able to do by any other method of fabrication—problems involving not only tensile strength, but a multiplicity of unpredictable high impact, fatigue, torsion, and bending stresses. In addition to this, we *know* that we have been able to effect substantial savings in construction cost. This statement is made with the full realization that our intimate studies of gas cutting and arc welding costs prove these operations to be expensive ones.

The writer particularly disagrees with the article referred to in regard to the figures on the physical properties of weld metal; he holds that the figures given do not represent anywhere nearly what can be obtained by the use of suitable commercially obtained rolled materials and electrodes. Over a period of years, we have conducted extensive investigations in welding steels of a wide carbon range, as well as practically all of the commercially obtainable low-alloy steels. These investigations included "as-welded" tests, and tests after heat-treatments at 1200 degrees F., stress relief, 1450

degrees F. anneal, and 1625 degrees F. normalization. They also included tensile, bend, fatigue, impact, and photomicrographic studies of the base metal, the affected zone, and the filler metal. To state that the ultimate obtainable in welds is 35,200 pounds per square inch yield strength, and 56,500 pounds per square inch ultimate strength is far from our experience. That statement is as unacceptable as would be a statement that these properties were 94,000 pounds per square inch yield strength, 105,000 pounds per square inch ultimate strength, and 180 degrees bend test. Yet we have actually obtained these values in our investigations. Naturally, they do not represent what we could hope to obtain in day-in and day-out practice. What the author appears to have done is to compare the *best* obtainable with a superior pearlitic iron with the *lowest* obtainable in welding.

May I cite our experience, which may not be applicable to the type of equipment discussed, but is indicative of what may result from ceaseless study of a particular design? We desired to change the design and construction of a certain type of equipment that constitutes a considerable volume of our sales. We wished to do this because the existing design in cast steel resulted in too many operating failures. The increase of cast-metal sections failed to correct our trouble; in fact it added to them. We were dealing with complicated details comprising very heavy sections joined to lighter ones. Planes of metal were joined with large fillets, and failures at these points always disclosed shrinkages, segregations, and cooling cracks.

This particular equipment was subject to extremely high impact stress, torsion, and bending. We felt that if this equipment could be produced from rolled steel having yield values of from 50,000 to 60,000 pounds, and if we could produce welded joints of greater over-all strength than the rolled material used, our problem would be solved. The material was available, we knew what we could obtain in filler metal strength, but our high hopes were shattered when we estimated the cost.

We discarded our design and started over—the result was the same. We started once again, and we continued to start over for eight consecutive times. It was only after repeated efforts that we finally evolved a design calling for local hot bending of steel, careful gas cutting, premachining, heavy fixtures, positioning machines, and heavy tie-bracing during heat-treatment. Thus we were successful. Today, this equipment is sold with a guarantee against breakage, and we make it at a cost below that of cast design.

One Hundred and Thirty Years of Manufacturing in the United States

HOW manufacturing in the United States has been transformed from small units in the home to great enterprises requiring hundreds of millions of dollars of capital is well told in the records of the U. S. Census Bureau. In 1810, the first Census of Manufactures was taken. The frequent surveys of American manufacturing from that time on tell a graphic story of the changing characteristics of American life.

The 1810 census shows that the great volume of production, particularly of such things as cotton and woolen cloth, took place in the home. Blacksmith shops constituted a principal industry. Grist mills and saw mills dotted the country. Other industries listed were fulling mills, hatteries, naileries, tanneries, saddleries, gunsmiths, tallow candle factories, carriage makers, snuff factories, straw bonnet factories, whip makers, coopers' shops, corn-broom factories, and gun powder factories.

Fabrication of raw materials was necessarily close to the consumer market. Each community converted its local products as far as possible to supply the needs of the local community, since absence of railroads and paved roads made transportation difficult.

By 1849, we find that the factory has more definitely begun to replace home industry. In that year, according to the census, there were in the United States 123,025 factories employing 957,069 workers. By 1899, the number of factories had increased to over 500,000, and the wage earners to over 5,300,000. By 1919, there were 9,000,000 wage earners, a figure that was reduced to 8,570,000 in 1937. In addition, the factories employed, in 1937, 1,217,000 salaried employes, so that the industries employed nearly 10,000,000 people—very nearly the same number of workers, including owners, directly employed on the country's 7,000,000 farms.

* * *

Aircraft Metal School Opened in California

A training school in aircraft metal production has been opened in Escondido, Calif., by John H. Engel. Owing to the highly specialized requirements of aircraft metal production, few aviation courses are sufficiently developed to cover various important phases of aircraft metal work. The present school, therefore, has been opened with the view of supplying this type of instruction. The school has five courses covering practical and theoretical aircraft metal work.

Modern Industrial Plant Lighting

Important Points to be Considered in the Lighting of Shops and Factories, and a Brief Review of New Developments in the Lighting Field—Based Upon Information Obtained from the Duro-Test Corporation, North Bergen, N. J.

THE three most outstanding faults in industrial lighting are inadequate light intensity, glare, and faulty distribution of the light. When the intensity of light is inadequate, vision is handicapped, resulting in slow and faulty performance of work. Furthermore, the workers are prevented from seeing accident hazards in time to avoid them. Worst of all, inadequate lighting may eventually be the cause of permanent eye defects.

Bright light sources or reflections in the field of vision temporarily blind the worker and cause him to walk into moving machinery, stumble over obstructions that he cannot see, or encounter other dangers. Glare also causes eye-strain and eventual permanent injury to the eyes.

Faulty distribution of light is a frequent cause of accidents. Shadowed areas conceal dangerous conditions and set the stage for injuries. Sharp contrasts of intensity create conditions of glare, with all the attendant dangers.

Relation of Industrial Accidents to Faulty Lighting

According to the Committee on Light and Safety of the Illuminating Engineering Society, 29 W. 39th St., New York City, there are twice as many industrial accidents during the winter months as during the summer—that is, industrial accidents increase with the decrease of daylight. It has been estimated that the annual loss due to accidents caused by poor lighting is close to $300,000,000, affecting about 100,000 industrial workers. Furthermore, 15 per cent of all industrial accidents are said to be due to defects in lighting.

A recent survey of lighting conditions in thousands of factories in five states revealed the average light intensity to be only 3 foot-candles. Daylight outdoors is measured at 1000 foot-candles in the shade, and ten times that much in sunlight. On the basis of a study covering a period of years, the Illuminating Engineering Society recommends standards of illumination that range from a minimum of 5 foot-candles—limited to use for very rough work—to 100 foot-candles for fine inspection work. In machine shops, the recommended range is from 10 to 100 foot-candles, depending on the type of work to be lighted.

In 1938, over $127,000,000 was spent in the United States for the purchase of incandescent lamps, an indication not only of the importance of the lamp industry, but also of the important part electric lighting plays in American life. This importance is emphasized by the Duro-Test Corporation, North Bergen, N. J., in calling attention to the fact that incandescent lamps should be designed with regard to the purpose for which they are to be used. For example, the lamp that is best adapted to use in the home may not be equally effective for factory lighting. In the home, the conditions under which the lamps burn are nearly ideal. They are used only a few hours at a time and are subject to very little vibration. In the factory, on the other hand, the lamps are burned for long hours under conditions of shock and vibration from heavy machinery.

Recent Developments in Incandescent Lamps

Hence, this company has developed lamps for industry that differ essentially from those designed for home use. The point is stressed that best results can be obtained only by using a lamp that is designed for its special requirements. The lamps in common use, obviously, are designed to give the best service under average conditions. Where vibration from machinery would affect the delicate filaments, lamps with special filaments and filament supports should be used to assure maximum burning hours.

The Duro-Test Corporation, therefore, has designed lamps to meet the individual problems of consumers, and guarantees to replace lamps that fail to burn 2000 hours. These lamps are not necessarily recommended for ordinary conditions of home use; but in commercial, industrial, or municipal use, when electric current is available at 3.3 cents a kilowatt-hour, or less, this specially designed lamp proves economical. Another innovation is that of marking on each lamp the rated amount of light, in lumens, and the number of hours for which the lamp is guaranteed to burn.

It is also pointed out that there is a choice between frosted and clear bulbs. Frosted bulbs may be ideal for use in one instance and yet not suitable for another. Frosting diffuses the light, and, hence, reduces the glare from an exposed bulb, but it also reduces the light output. It is therefore

considered more economical to use a clear glass bulb behind an opaque glass. Mirrored or semi-mirrored lamps, suitable for use in one place, may not be suited for another. Lighting experts are able to offer advice to commercial and industrial users as to the most efficient and economical type of lamps to use.

The Fluorescent Electric Lamp

A recent development in the electric light field which promises to occupy a constantly increasing field of usefulness is the fluorescent lamp, which consists of a long, gas-filled tube coated with a chemical powder. The powder is activated by rays from a mercury arc, so as to give out light. Such lamps will give from three and one-half to ten times more light than the ordinary incandescent lamp with corresponding current consumption. Since the introduction of the fluorescent lamp, there has been a growing demand for a unit that would require no special wiring, and that could be easily and quickly installed like the ordinary electric lamp connected to a current outlet.

A complete unit — reflector and auxiliary — for fluorescent lamps that meets these requirements has been developed by the company mentioned. It is equipped with an extension cord, so that it can be plugged into any current outlet, or it can be screwed into a standard electric light socket. These fluorescent tubes are generally available in daylight white, soft white, blue, green, red, pink, and gold light. A so-called "incandescent white," which is very similar to the light given out by the ordinary incandescent lamp, has been developed by the company.

The economy of fluorescent lighting, as compared with the regular incandescent lamps, is especially interesting in view of the constant increases in light output for the average incandescent lamp in the last ten years; and yet, with the adoption of fluorescent lamps, the present lighting dollar will purchase three and a half times as much light as formerly.

* * *

Electronic Indicator for Use in Making Accurate Measurements

By R. G. MINARIK

Assistant Professor of Mechanical Engineering
Armour Institute of Technology, Chicago, Ill.

The problem of making accurate measurements or settings independent of a machinist's or operator's skill is frequently encountered in modern shop practice. A well developed "feel" usually yields consistent micrometer readings when taken from rigid bodies; but even the most skillful have difficulties in obtaining reasonably uniform measurements from easily deformed objects, such as delicate springs.

Occasionally a flashlight bulb and dry cell are connected to the measuring device in such a way that contact of its movable anvil with the object to be measured completes the circuit and lights the lamp. However, the resistance of contact and the deformability of an object often make such a procedure surprisingly inconsistent in its results. Another objection to this procedure lies in the arcing which occurs at the time of initial contact, resulting in discoloration, pitting, or even drawing of the temper of extremely fine-edged cutters.

The inexpensive arrangement shown in the accompanying diagram was devised to overcome the difficulties outlined. The circuit is not critical, and the methods of application are self-evident. The parts for the indicator itself should not cost more than $10. The special transformer, made by A. C. Rittenhouse, Honeoye Falls, N. Y., is necessary for the power requirements of the circuit and the isolation of the circuit from any external lighting

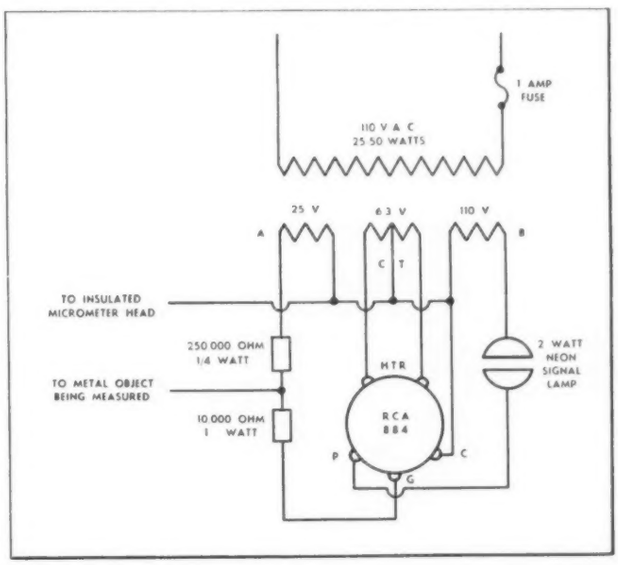


Diagram of Electronic Indicator Circuit Developed for Use in Making Precision Measurements

circuit grounds. A current flow of less than one-thousandth of an ampere through the contact point is all that is necessary to flash the neon signal lamp. This low current enables operation with practically zero contact pressure and precludes any danger of arcing. It also makes the device suitable for use with objects having relatively poor conductivities. In making the connections to the transformer, it is important to be sure that the reading of a voltmeter across *A-B* is 135 and not 85 volts.

* * *

In 1937, the value of manufactured aircraft and parts, according to the census figures, was $107,000,000. It is estimated that the annual production of the aircraft industry at present amounts to more than $300,000,000.

Change-Gears for Helical-Gear Hobbing

Group Calculations for Selecting Gears to be Employed in Hobbing Machines Equipped with Differential Mechanism

By RUSSELL H. STOUT

MUCH has been written concerning the selection of change-gears for hobbing helical gears on machines without differentials or "jack in the box" mechanisms, but comparatively few articles have appeared dealing with the change-gear problem when using machines of the differential type. Probably the reason for this is that the actual selection of four gears is a "hit and miss" method that represents or approximates more or less accurately the correct ratio. If the five or six million four-gear combinations possible with change-gear tooth numbers ranging from 20 to 90 had been calculated and put in order, gears of the required ratio might be selected by direct reference to such a table, but these ratios would fill several volumes, which explains why they have never been calculated.

With machines containing differentials instead of the usual index and feed gears, we have three sets of gears—the indexing gears, the feed gears, and the differential gears. The first two sets can easily be selected from the plates on the machines, and are fixed. For example, in cutting gears having, say, 33 teeth, the same index gears are always used, regardless of the angle of the helix or "spiral" on different gears. Likewise, if the proper feed is 0.030 inch, the feed gears will not vary.

Ratio of the Differential Gears

The third set of gears is variable, and must be calculated for each individual case. The change-gears needed represent the

$$\frac{\text{Machine Ratio}}{\text{Lead of Helix}} = \frac{\text{Drivers}}{\text{Driven}} \qquad (1)$$

The machine ratio in most machines is some multiple of 15, such as 7.5, 15, or 30. The lead of the helix refers, of course, to the lead of the helix of the gear to be cut. This ratio (1) can be figured for each individual case, but a better method is to figure a "general case" for a *given angle* and a *given diametral pitch*. When such a general case is figured by the method to be described, only one gear in the change-gear group need be changed when a gear of another number of teeth is to be cut, assuming that it has the same angle and the same diametral pitch, and no further calculations are necessary. The idea in mind is to select a group of change-gears for the differential mechanism which will contain, as a driven gear, a gear containing the same number of teeth as the gear to be cut. If this is done properly for, say, a 30-tooth gear, then when a 31-tooth gear is to be cut, the only change necessary is to displace the 30-tooth driven gear with a 31-tooth gear and the machine is ready.

Example of Change-Gear Calculations

Suppose we have a gear to be cut which is right-hand and has a 10 normal diametral pitch, 30 teeth, a lead of 17.785 inches, and a 32-degree angle of helix. The machine ratio is 7.5.

The lead of any helical gear can be found by the following formula, in which N = number of teeth; θ = angle of helix; and $D.P.$ = normal diametral pitch:

$$\text{Lead} = \frac{\pi \times N}{D.P. \times \sin \theta} \qquad (2)$$

Substituting in Formula (1), we have,

$$\frac{7.5}{\frac{\pi \times N}{D.P. \times \sin \theta}} \quad \text{or}$$

$$\frac{7.5 \times D.P. \times \sin \theta}{\pi \times N} = \frac{\text{Drivers}}{\text{Driven}} =$$

$$\frac{7.5 \times 10 \times 0.529919}{N \times 3.141593} \qquad (3)$$

The four gears will be represented by $\frac{A \times B}{N \times C}$ (4)

If this equation is solved with the gear N as a factor in the denominator, then the other three gears will not need to be changed when gears having other numbers of teeth are to be cut. We will now determine the values for A, B, and C. Since it makes no difference what value is used for gear N in Equation (4), in view of the fact that Equations (3) and (4) are always true for any 10-pitch gear with a 32-degree helix angle, we will assume a value of 1 for N. As gear A must be in the range of available change-gears, we will assume that it must have between 20 and 80 teeth. Then B/C can have only 60 values (80 — 20 = 60, or one value for each tooth number).

When A and N in (4) both equal unity, the value of B/C equals 12.6508.

$$\frac{7.5 \times 10 \times 0.529919}{3.1416} = 12.6508$$

When A = 20, then B/C becomes 0.632545

Table 1

A	B/C	A	B/C	A	B/C
20	0.632545	41	0.308556	62	0.204045
21	0.602419	42	0.301209*	63	0.200806
22	0.575035	43	0.294205	64	0.197670*
23	0.550034	44	0.287517	65	0.194627
24	0.527116	45	0.281128	66	0.191678
25	0.506032*	46	0.275017	67	0.188818
26	0.486569	47	0.269166	68	0.186041*
27	0.468548	48	0.263558	69	0.183345*
28	0.451814	49	0.258179	70	0.180725*
29	0.436234	50	0.253016*	71	0.178180
30	0.421693*	51	0.248055	72	0.175706
31	0.408090	52	0.243284	73	0.173298
32	0.395340*	53	0.238694	74	0.170956
33	0.383357	54	0.234272	75	0.168677*
34	0.372082*	55	0.230014	76	0.166457
35	0.361451*	56	0.225907	77	0.164296
36	0.351413	57	0.221943	78	0.162188
37	0.341913	58	0.218127	79	0.160136
38	0.332915	59	0.214420	80	0.158136
39	0.324379	60	0.210846		
40	0.316272	61	0.207390		

(12.6508 ÷ 20 = 0.632545). When $A = 21$, then B/C becomes 0.602419. Table 1 contains all values of A between 20 and 80.

The values marked with asterisks (*) in this table are what might be termed *usable* values. To select these quickly, it is necessary to have a table of decimal equivalents of fractions representing gear ratios. [See Brocot's Tables, "Manual of Gear Design," Section 1, page 148.] We will now consider a few of the possible combinations.

The first value in Table 1 that is very close to the decimal equivalent of an available pair of change-gears is 0.506032. The nearest value in the table of decimal equivalents is 0.506024 with $\frac{42}{83}$ as the fraction representing the value. The difference between these values is 0.000008. Some other numbers and their equivalent values are as follows:

A Value	*B/C* Value	Dec. Equiv. Table Value	Fraction	Difference
25	0.506032	0.506024	42/83	— 0.000008
30	0.421693	0.421686	35/83	— 0.000007
34	0.372082	0.372093	16/43	+ 0.000011
64	0.197670	0.197674	17/86	+ 0.000004
70	0.180725	0.180723	15/83	— 0.000002

While the number with the A value of 64 is lower in difference than the one with an A value of 30, the one with the A value of 30 will make a more desirable combination. This can be shown by an example. Taking the A value as 64, with its corresponding fractional value of 17/86, we have for the general formula, substituting in Equation (4),

$$\frac{64 \times 17}{N \times 86} \text{ or } \frac{32 \times 34}{N \times 86}$$

This is an excellent combination and will give very close results, but if we consider that 10 was the normal diametral pitch used in this case, and we wish later to solve for some gears of 8 diametral pitch and 32-degree angle, it will be necessary to make another table (if we have not saved this one), while if we select another combination of figures at the start, much time may be saved by cancellation. To illustrate again, taking the A value as 30 and the fractional value as 35/83, we have for the general formula:

$$\frac{30 \times 35}{N \times 83}$$

This can be used much more extensively, because if we wish to change from 10 pitch to 8, all that is necessary is substitution by cancellation. Thus,

$$\frac{30 \times 35}{N \times 83} \times \frac{8}{10} = \frac{24 \times 35}{N \times 83}$$

Now we have the general formula for an 8-pitch gear of the same helix angle. This idea should be kept in mind when selecting values. In some cases, factorable numbers will not appear in the solution, as they did in this case, but when they do appear, advantage should be taken of them.

As was shown, if the pitch of the gear to be cut is changed from, say, 10 pitch to 8, merely a substitution in the numerator of the general formula provides the change-gear combination for 60 more gears (making the total 120) without further work. To illustrate further, some examples are shown in Table 2.

A difference between the actual lead of the gear and the lead obtained by the change-gears selected should not be much, if any, over 0.00015 per inch of lead. For a lead of 17.785, such as we have in the gear selected, it should not be over 0.0025 or 0.003 inch.

Proof of the Formula

By rearranging Formula (1), we have:

$$\text{Lead of spiral} = \frac{\text{Driven} \times \text{Machine Ratio}}{\text{Drivers}}$$

By substitution:

Table 2

Normal Diametral Pitch	Helix Angle, Degrees	Number of Teeth on Gear to be Cut	Change-Gears
10	32	General Formula	$\frac{30 \times 35}{N \times 83}$
10	32	33	$\frac{30 \times 35}{33 \times 83}$
10	32	65	$\frac{30 \times 35}{65 \times 83}$
8	32	33	$\frac{24 \times 35}{33 \times 83}$*
8	32	65	$\frac{24 \times 35}{65 \times 83}$

*Since the pitch has been changed from 10 to 8, the change-gears equal the combination for 10 pitch and 33 teeth multiplied by 8/10.

$$\frac{30 \times 35}{33 \times 83} \times \frac{8}{10} = \frac{24 \times 35}{33 \times 83}$$

$$\frac{30 \text{ (No. teeth to be cut)} \times 83 \times 7.5}{30 \text{ (from the formula)} \times 35}$$

$$= 17.7857 \text{ inches}$$

This value (17.7857) is the lead desired.

The question naturally arises as to whether or not the time involved in making a table will repay one for the effort required. Since there are sixty numbers to be computed (assuming that sixty change-gears are available) and a selection is to be made after the numbers are arranged, a time study will be in order. The making of a table should not take more than two hours at the outside, including the selection of the most suitable value and the proof of the formula. (If a calculating machine is used, the time will be much shorter.)

In other words, in two hours one should (1) compute all 60 values of B/C; (2) select values that have fractional equivalents represented by available change-gears (marked * in Table 1); (3) select one value from group (2) for the formula; (4) prove the formula with at least one gear (as previously shown).

Many short-cuts may be used. For example, when $A = 20$ and the value of $B/C = 0.632545$ (see Table 1), then the B/C value when $A = 40$ will be reduced one-half. Thus, $0.632545 \div 2 = 0.316272$, which is the B/C value when $A = 40$. Similarly, if $A = 80$, the B/C value is one-half that when $A = 40$. The B/C value, when $A = 72$, may be computed from the 80 value by moving the decimal point one place to the right and dividing by 9. Thus, $1.58136 \div 9 = 0.175706$. If the factors are kept in mind, a great portion of the table can be filled out in this way. The "primes," of course, must be computed by long division.

It will be seen that after the formula is established, the whole range of gears for a given angle and pitch is solved, and in some cases, as in the preceding one, all the gears for several other pitches are also calculated. Like all other systems with which the author has come in contact, there are points in this one which make it undesirable under certain conditions. If the gear has a low helix angle (such as 5 degrees), the method is not so efficient as when applied to larger angles, such, for example, as 18 or 20 degrees, or larger. This is because the smaller the helix angle, the longer the lead, and, as the machine constant remains the same for any given machine, this lowers the B/C values. In the example given for a gear of 10 normal diametral pitch and 32-degree helix angle, the B/C values range from 0.632545 to 0.158136, as previously shown (see Table 1).

In any table of decimal equivalents of fractions ranging from 1/100 to 99/100, there are 1482 equivalents between these two numbers. If there are only 60 values for B/C, this means that there is an average of about 24 equivalents for each B/C number ($1482 \div 60 = 24 +$). As a result, the intervals are closer together and the chance of "hitting" an equivalent is much greater than for a gear of 10 normal diametral pitch and 5-degree helix angle. For the smaller angle, the B/C values range from 0.10403 to 0.02601.

In the table containing a total of 1482 decimal equivalents, there are only about 250 equivalents for this range of B/C values, from 0.10403 to 0.02601. Since there are still 60 values for B/C in the example referred to, this makes only 4 equivalents for each B/C number, as compared with 24 for the higher helix angle. For this reason, the intervals are farther apart and one is not so likely to find an equivalent.

New Air-Hardening Tool and Die Steel

DESIGNED to replace steels requiring liquid quenching for developing the characteristics desired in dies, punches, and similar tools, a new air-hardening tool steel has recently been brought out by the Bethlehem Steel Co. with the following approximate analysis: Carbon, 1 per cent; manganese, 2 per cent; chromium, 2 per cent; and molybdenum, 1 per cent.

The advantages offered by the new steel are: (a) Good hardenability when air-quenched, comparable to many liquid-quenched die steels. (b) Low quenching temperature, ranging from 1550 to 1625 degrees F., which is 100 to 200 degrees F. below that required for ordinary air-hardening die steels of equal hardness. This simplifies the furnace operation, lessens the chance of overheating the corners of a machined die, and minimizes distortion and danger of cracking. (c) Satisfactory machinability in annealed condition. (d) High abrasion and wear resistance. (e) Ease of heat-treatment. (f) Good hardness penetration.

In the forging of this steel, slow and uniform heating is important, preferably between 1950 and 2000 degrees F. If a preheater is available, it is advantageous to maintain the temperature at 1200 degrees F. until the parts are thoroughly heated, before they are brought to full temperature in the forging furnace. The forging temperature must not drop below 1500 degrees F., and if necessary, the parts should be reheated. Owing to their air-hardening properties, the forged parts should be cooled in lime, ashes, silocel, or some other heat retaining medium.

The annealing cycle prescribed has two purposes —to produce a steel with good machinability, and to develop a structure that will insure effective response in air-hardening. A Brinell hardness under 229 on small and medium-sized parts is de-

veloped by heating slowly and uniformly to 1600 degrees F., holding at that temperature for at least one hour per inch of average thickness, and cooling at a rate of 20 degrees F. per hour, down to about 400 degrees F. The parts are then reheated to 1325 degrees F., and held at this temperature for about 4 hours per inch of thickness. Finally they are removed from the furnace and cooled to room temperature.

An alternate annealing cycle may be used, provided slightly greater hardness is not objectionable. This cycle consists of heating slowly to 1400 degrees F. and holding at that temperature at least one hour per inch of thickness of the average dimensions. Cooling is carried out at the rate of 20 degrees F. per hour to 900 degrees F., followed by furnace cooling to room temperature.

Hardening of the New Die Steel

Care must be exercised in heating and quenching, in order to keep distortion to a minimum and prevent decarburization. The steel should always be heated slowly to the hardening temperature. Pack-hardening is advocated for large parts to insure maximum surface hardness. If possible, it is well to preheat to about 1200 degrees F., and soak thoroughly at that temperature. The recommended hardening temperature is 1550 to 1625 degrees F., depending on the size of the piece. The pieces should be held at the hardening temperature for 1 hour per inch of average thickness. They are then air-cooled. For large dies, an air blast should be directed against the face during hardening.

Table 1. Fracture Ratings and Rockwell Hardness

Treatment Degrees F., Still Air	Fracture Rating	Rockwell Hardness
1450	9 1/4	57
1500	9 3/4	62
1550	9 3/4	63
1600	9 1/2	63
1650	9	63
1700	8 3/4	63
1750	5	46
1800	4 1/2	44

Parts are charged into the tempering furnace after cooling to about 200 degrees F. The temperature is then raised slowly to between 325 and 375 degrees F., depending upon size and degree of hardness desired, and maintained at this temperature for at least 1 1/2 hours per inch of average thickness. This is followed by slow cooling to room temperature.

Data on Physical Properties

A series of tests made to determine the physical properties was carried out on a steel of the following analysis: Carbon 0.95 per cent; manganese, 2.04 per cent; phosphorus, 0.016 per cent; sulphur, 0.017 per cent; silicon, 0.23 per cent; chromium, 1.93 per cent; and molybdenum, 1.04 per cent. Except for the distortion tests, the specimens were taken from 1-inch square annealed bar stock. For the distortion tests, 1 1/4-inch samples were cut from annealed forgings 5 1/2 inches in diameter, upset from 4 1/2-inch square billet stock.

Critical points were determined by dilatometric tests on 1-inch round specimens, heated and cooled at the rate of 400 degrees F. per hour, and gave the following ranges: Heating: Ac range, 1370 to 1440 degrees F.; Cooling: Ar range, 1300 to 580 degrees F.

Table 2. Rockwell Hardness in Tempering Tests

Tempering Temperature, Degrees F.	Hardening Temperature, Degrees F., Still Air				
	1500	1550	1600	1650	1700
	Rockwell Hardness				
Not Tempered	62	63	63	63	63
300	59	61	61	60 1/2	61
400	58	60 1/2	60	60	60
500	57	59	59	58 1/2	59
600	56	57 1/2	57	57	57
700	55	57	57	57	57
800	54	56	56	56	56
900	51	54	54	53 1/2	54
1000	49	52 1/2	53	53	53
1100	45	48	49	49	48
1200	37	39	39	40	39
1300	27	28	28	28	28

For hardness tests, specimens 1-inch square and 4 inches long were hardened in still air at temperatures ranging from 1450 to 1800 degrees F., at 50-degree intervals. The hardened specimens were then fractured, and the fracture ratings and Rockwell hardness determined. The results obtained are given in Table 1.

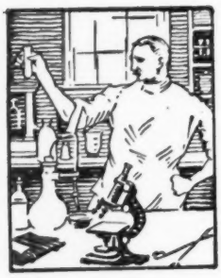
For tempering, specimens 1-inch square and 2 inches long were hardened in still air at 1500, 1550, 1600, 1650, and 1700 degrees F. Tempering was then carried out at temperatures ranging from 300 to 1300 degrees F. The results obtained are given in Table 2.

Changes in the dimensions of the test piece in inches per inch, due to distortion after the various steps in the heat-treatment, are shown in Table 3. In each case, the results shown represent the changes in the annealed test piece.

Table 3. Distortion in Heat-Treatment

Dimension in Inches, Annealed	Change, in Inches per Inch	
	Air-Hardened at 1550 Degrees F.	Air-Hardened at 1550 Degrees F., Tempered at 300 Degrees F.
4.99825	0.00067	0.00040
2.89875	0.00095	0.00077
0.50075	0.00210	0.00190
1.89625	0.00102	0.00102
1.00150	0.00013	0.00038

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Nickel and Chromium Bonded to Aluminum Sheet

Two new pre-finished bonded metals combining the attractiveness and durability of nickel and chromium with the lightness, strength, and workability of aluminum have recently been introduced by the American Nickeloid Co., of Peru, Ill. In each of these materials, the chromium or nickel surface is bonded to the aluminum by an electrolytic process which prevents subsequent peeling. Under test, two pieces of pre-finished nickel aluminum, when soldered together and then pulled apart, showed rupture of the solder without peeling of the nickel coating. Thus, the manufacturer states that sheets can be bent, stamped, or moderately drawn without damage to the permanently bonded finish.

Because the aluminum does not have to be etched for bonding, no dulling of the plated surface occurs. A choice of bright or satin finishes and striped, crimped, or corrugated patterns permits these metals to be readily adapted to many uses and designs. They are available in sheets up to 36 by 96 inches, and in gages from 0.010 to 0.064 inch, with a full range of tempers. 201

Porce-Tite—A New Paint that is Waterproof

A material that can be applied as easily as paint and yet will stop water seepage and keep water out, should fill a real need both in industry and elsewhere. Porce-Tite, a material distributed by the Bedard & Morency Mill Co., 101 N. Lombard Ave., Oak Park, Ill., has been placed on the market to meet these requirements. It is a white, waterproof paint, which is claimed to be economical in cost, easy to apply, odorless, truly white, and a reflector of light, making it desirable for interior use in industrial plants, basements, etc.

It can be applied to surfaces such as cement, concrete, face and common brick, cement and cinder block, stucco, clay tile, cast and natural stone, asbestos siding, plaster board, and fiber building board. It is not suitable for use on wood, plaster, metal, or surfaces painted with oil paints or spotted with oil and grease. However, it can be used over other painted surfaces (not oil paints) which have been thoroughly weathered or on surfaces that can be wire-brushed clean or roughened to secure a good bond. A clean surface is essential.

Since the paint is immune to most fumes and acids, it has found ready use in many industrial plants. The paint sets in about three hours, and becomes hard in twenty-four hours under ordinary weather conditions. It requires about five days to "cure" thoroughly. It can be mixed into any consistency from a cement-like compound for filling cracks and crevices to a free-flowing paint. While it gives a fine white finish in itself, any paint, calcimine, or casein can be applied over it. 202

How Minute Amounts of Beryllium Improve Copper Characteristics

Beryllium is playing an important role in making possible many applications of resistance welding, according to Dr. R. H. Harrington of the General Electric Research Laboratory. Just one part in a thousand of this metal plus four parts in a thousand of chromium so greatly improve the qualities of copper that welding electrodes made from the resulting material decidedly outlast ordinary copper electrodes, withstand the high pressures and impacts prevalent in the welding process, and produce uniform results.

This copper-beryllium-chromium alloy, which is known as Trodaloy, has a somewhat lower electric conductivity than pure copper, but it is much harder and tougher, and can be used at higher temperatures. It is being used not only for welding electrodes, but also for switch plates, cams, spring fingers, and other electrical and mechanical parts requiring high electric conductivity.

The development of beryllium-copper alloys has increased the use of beryllium and materially reduced its cost. In 1923, when no useful application of beryllium was known, the market price of this metal was $5000 a pound. Today the price has been

To obtain additional information about materials described on this page, see lower part of page 142.

brought down to about $23 a pound as a result of more efficient methods of production and increased demand. Beryllium is a third lighter than aluminum, and weighs only about one-fourth as much as steel, although it has 90 per cent of the tensile strength of that metal. 203

Metal Parts Impregnated with Graphite to Reduce Abrasion

The impregnation of surfaces of metal parts with graphite so as to provide long-lasting self-lubricating properties is a recent process that has been applied by the automotive industry for such parts as piston-rings, valve guides, pistons, torque-ball studs, clutch retainers, thrust washers, axle shafts, ring gears and pinions, idler-gear pins, and rocker-arm supports.

This process consists of first subjecting the parts to a chemical action, which creates a granular structure on the surfaces to be treated, and then dipping the part in a bath of "dag" colloidal graphite suspended in oil. The colloidal graphite is carried into the porous granular structure, forming a bond with the metal. Much of the success of the treatment is said to be due to the development of a new form of colloidal graphite in which the dag particles, according to the Acheson Colloids Corporation, Port Huron, Mich., are less than 1 micron (forty-millionths inch) in size. 204

Nickel-Chromium-Molybdenum Steel Shafts Used on Industrial Trucks

Axle drive-shafts made from a nickel-chromium-molybdenum steel are now being provided on the industrial trucks built by the Baker-Raulang Co., Cleveland, Ohio, to insure the strength and toughness required for the severe service demanded of this type of material-handling equipment. These shafts, which are 1 5/8 inches in diameter by 30 inches long, transmit power directly from the differential drive to the wheels. Torsional and fatigue loads are heavy, and there is a considerable impact load.

The analysis of the steel from which the shafts are made is as follows: Carbon, 0.40 to 0.50 per cent; manganese, 0.50 to 0.80 per cent; phosporus, 0.04 per cent maximum; sulphur, 0.05 per cent maximum; nickel, 1.50 to 2 per cent; chromium, 0.60 to 0.90 per cent; and molybdenum, 0.15 to 0.25 per cent.

The shafts are heated for two hours at 1525 degrees F., quenched in oil, and drawn at 1000 degrees F. for half an hour. This heat-treatment produces the following physical properties: Tensile strength, 180,000 pounds per square inch; yield point, 165,000 pounds per square inch; elongation in 2 inches, 15 per cent; reduction of area, 50 per cent; and hardness, Brinell 354.

This steel has particularly good depth hardening properties and machines well in the heat-treated condition, all machining being done after heat-treatment. This includes cutting off, hobbing splines, chamfering, and finish-grinding. 205

Low-Temperature Silver Brazing Alloy Used on Heavy Current Conductors

A low-temperature silver brazing alloy is being used by Sperry Products, Inc., Hoboken, N. J., to join the parts of heavy copper current conductors for rail-welding equipment. The conductor arms are made of copper bars, 1/4 inch thick by 6 inches wide, brazed into slots 3/4 inch deep in copper castings. The brazing alloy contains a medium percentage of silver, and flows freely at 1175 degrees F. A flux is used which is fluid and active at 1100 degrees F. Both the brazing alloy and flux are supplied by Handy & Harman, New York City.

Joints made with this alloy are ductile, have high tensile strength and a conductivity as high as copper, cannot oxidize, and never require cleaning. The free-flowing brazing alloy forms a solid joint with little alloy remaining outside, so that finishing is held to a minimum.....206

A Motor Built by the Allis-Chalmers Mfg. Co., in which All the Coils are Insulated with Woven Glass Tape, Permitting It to Run at Very High Temperatures, thus Producing More Power for Its Size. The Motor Shown is Rated at 250 H.P., 400 R.P.M., 230 Volts Direct Current

To obtain additional information about materials described on this page, see lower part of page 142.

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Check on Form at Bottom of Page 141 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the March Number of MACHINERY

Gear Finishing and Checking Equipment

MICHIGAN TOOL CO., 7171 E. McNichols Road, Detroit, Mich. Booklet containing information on gear finishing by the crossed-axis shaving method; lapping; and locating gear troubles. Descriptions and specifications covering the complete line of gear finishing and checking equipment made by this concern are included. 1

Continuous-Feed Facing and Boring Head

GIDDINGS & LEWIS MACHINE TOOL CO., Fond du Lac, Wis. Circular descriptive of a new continuous-feed facing and boring head for G & L high-power, precision, horizontal boring, drilling, and milling machines. Illustrations show various applications for which the attachment is adapted. 2

Roller Chain Engineering Data

MORSE CHAIN CO. DIVISION OF BORG-WARNER CORPORATION, Ithaca, N. Y. Engineering data bulletin R-54, containing information on construction, capacities, and applications of Morse roller chain; power transmission capacity tables; guide for calculating chain lengths; proper chain drive lay-out, a discussion of types of oiling systems, etc. 3

Standardized Industrial Bearings

BUNTING BRASS & BRONZE CO., Toledo, Ohio. Catalogue 40, covering the line of standardized bearings made by this concern, including many new sizes of industrial bearings, electric motor bearings, and graphited oil-less bearings. Precision bronze bars and babbitt metals are also listed. 4

Industrial Paint-Spraying Equipment

MILLER-SIMONS INC., 2900 S. 61st Court, Cicero, Ill. Leaflet descriptive of Miller-Simons moderate-priced industrial paint-spraying equipment, including spray guns, tank and portable compressor units, and a miniature paint spray unit for miscellaneous intermittent service. 5

Welding Guide

THE LINDE AIR PRODUCTS CO., UNIT OF UNION CARBIDE AND CARBON CORPORATION, 30 E. 42nd St., New York City. Chart giving recommended welding methods, flame adjustments, welding rods, and fluxes for thirty commonly used metals and alloys. 6

Conveyors

LINK-BELT CO., 307 N. Michigan Ave., Chicago, Ill. Catalogue 1700, containing illustrations of innumerable applications of mechanical elevating and conveying equipment for handling both packages and loose bulk materials with greater facility and at lower cost. 7

Lubrication with a "Stop Signal"

ALEMITE DIVISION OF STEWART-WARNER CORPORATION, Diversey at Wolcott, Chicago, Ill. Circular 21-17, descriptive of Alemite Lubrigards, a new line of fittings and bushings for industrial machinery designed to prevent over-lubrication of ball and roller bearings. 8

Multi-Purpose Tools

H & H RESEARCH CO., 1925 W. Buena Vista, Detroit, Mich. Circular describing the Hoover motor-driven multi-purpose tool suitable for honing, filing, chipping, sawing, and a variety of operations in the tool and die room formerly requiring hand tools. 9

Metal Analysis Equipment

HARRY W. DIETERT CO., 9330 Roselawn Ave., Detroit, Mich. Catalogue 107, descriptive of the use of the spectrograph for the analysis of metals, and other instruments for the determination of carbon, sulphur, etc., in ferrous and non-ferrous materials. 10

Rotary Sheet-Metal Working Machines

NIAGARA MACHINE & TOOL WORKS, 637 Northland Ave., Buffalo, N. Y. Bulletin 75A, covering the latest Niagara hand- and power-operated rotary machines for burring, beading, crimping, flanging, and other sheet-metal work. 11

Industrial Lighting Equipment

ACME ELECTRIC & MFG. CO., Cuba, N. Y. Bulletin 149, entitled "Light for Work," describing Acme mercury vapor transformers for indoor and outdoor applications. Tables and charts are included of value in determining the proper lighting system for a plant. 12

Corrosion-Resistant Sheet Metal

AMERICAN NICKELOID CO., Peru, Ill. Circular announcing nickel- and chromium-plated aluminum sheet suitable for making any product that requires the use of a light-weight, workable, corrosion- and wear-resistant metal. 13

Mounted Abrasive-Wheel Chart

CHICAGO WHEEL & MFG. CO., 1101 W. Monroe St., Chicago, Ill. Wall type mounted-wheel chart, showing in actual size all the standard sizes and shapes of abrasive wheels mounted on steel mandrels, available for tool-rooms and other uses. 14

Surface Grinding Machines

BERGRAM MECHANICAL ENGINEERING CO., INC., New Britain, Conn. Bulletin illustrating and describing the new Bergram production surface grinder, designed for grinding comparatively small parts to close tolerances and high finish. 15

Industrial Heaters

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Catalogue

28-000, covering new and improved electric heating units and controls, designed to meet specific industrial applications for heating liquids, solids, and air. 16

Tap and Drill Chart

DUMORE CO., Racine, Wis. Chart for use in shops, drafting-rooms, and engineering departments, containing tables of tap drill sizes; twist drill and steel wire gage; decimal equivalents; and wire gages in approximate decimals of an inch. 17

Automatic Chucking Machines

PRODUCTION MACHINERY SALES CO., 4845 St. Aubin Ave., Detroit, Mich. Catalogue describing the features of construction of a new type of single-spindle automatic chucking machine equipped with a turret, known as the Verti-Hydra-Matic. 18

Automatic Tapping Machines

FREW MACHINE CO., 132 W. Venango St., Philadelphia, Pa. Bulletin 113, illustrating and describing Frew automatic tapping machines designed for speed, accuracy, ease of operation, and simplicity of adjustment. 19

Automatic Molding Machines

F. J. STOKES MACHINE CO., Tabor Road, Philadelphia, Pa. Catalogue 906, on Stokes automatic molding machines for molding plastics. Data on production costs of actual parts is included. 20

Motion Pictures

GENERAL ELECTRIC CO., Schenectady, N. Y. Catalogue listing the motion pictures offered by this company for the use of organized groups, such as educational institutions, churches, and social, civic, and business clubs. 21

Screwdrivers and Soldering Irons

STANLEY TOOLS, New Britain, Conn. Bulletin 135, illustrating a wide variety of screwdrivers made for industrial use. Leaflet listing Stanley plug-tip electric soldering irons. 22

Graphited Bronze Bearings

BOUND BROOK OIL-LESS BEARING CO., Bound Brook, N. J. Circular containing data on Bound Brook graphited bronze bearings, including permissible loads, dimensions and tolerances, installation and application. 23

Electric Motors

CROCKER-WHEELER ELECTRIC MFG. CO., Ampere, N. J. Bulletins 250 and 251-A, describing, respectively, Form A alternating-current polyphase induction motors, and alternating-current polyspeed motors. 24

Safety Appliances

JUNKIN SAFETY APPLIANCE CO., Louisville, Ky. Booklet entitled "Stamping Presses — Their Safety, Uses, and Abuses." Circular descriptive of the Junkin triple interlock guard for stamping presses. 25

Universal Grinding Machines

BROWN & SHARPE MFG. CO., Providence, R. I. Catalogue illustrating the Brown & Sharpe Nos. 2, 3, and 4 universal grinding machines suitable for a wide variety of tool-room and production grinding. 26

Electrical Measuring Instruments

LEEDS & NORTHRUP CO., 4934 Stenton Ave., Philadelphia, Pa. Catalogue N-33B, covering Micromax and Speedomax Rayotube pyrometers and their application on a variety of temperature measuring work. 27

Segment Saws

PITTSBURGH SAW & TOOL CO., 75-81 Sycamore St., Pittsburgh 23, Pa. Catalogue descriptive of the Pittsburgh segment saw, in which the segments are held in place with wedges instead of rivets. 28

Temperature-Indicating Equipment

LEWIS ENGINEERING CO., Naugatuck, Conn. Circular descriptive of portable pyrometer potentiometers and accessories, suitable for use in moving vehicles and airplanes. 29

Spot-Welding Machines

PIER EQUIPMENT MFG. CO., Milton and Cross Sts., Benton Harbor, Mich.

To Obtain Copies of New Trade Literature

listed on pages 140-142 (without charge or obligation) mark with X in the squares below, the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	

Name ..... *Position or Title* .....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

Firm .....

Business Address .....

City ..... *State* .....

[SEE OTHER SIDE]

Catalogue 40, illustrating and describing the complete line of Ace spot-welders made in both manual and automatic types. 30

Flexible Couplings

D. O. JAMES MFG. CO., 1120 W. Monroe St., Chicago, Ill. Circular outlining advantages and giving complete specifications, including list prices, of James flexible couplings and universal couplings. 31

Continuous Filing Machines

CONTINENTAL MACHINES, INC., 1312 S. Washington Ave., Minneapolis, Minn. Folder illustrating and describing the Continental continuous band filing machine, made in both bench and floor models. 32

Metal-Sawing Machines

PEERLESS MACHINE CO., Racine, Wis. Bulletin 50, illustrating and describing the company's complete line of high-duty, hydraulic, automatic metal-sawing machines. 33

Tungsten-Carbide Tools

WILLEY'S CARBIDE TOOL CO., 1340 W. Vernor Highway, Detroit, Mich. Catalogue 24, containing a number of useful tables on the application of tungsten-carbide tools. 34

Speed Reducers

JANETTE MFG. CO., 556 W. Monroe St., Chicago, Ill. Bulletin 22-25C, covering the complete line of Janette speed reducers suitable for any slow-speed application from 1/50 to 10 H.P. 35

Roller Bearings

BOWER ROLLER BEARING CO., 3040 Hart Ave., Detroit, Mich. Supplement No. 2 to "Bower Engineering Journal," giving latest information on the line of tapered roller bearings made by this concern. 36

Vibrating Conveyors and Screens

AJAX FLEXIBLE COUPLING CO., Westfield, N. Y. Bulletins 28, 29, and 30, covering, respectively, Ajax vibrating screens; conveyors and feeders; and packers. 37

Materials-Handling Equipment

LEWIS-SHEPARD SALES CORPORATION, 175 Walnut St., Watertown, Mass. Circular illustrating and describing Lewis-Shepard lift trucks, skid platforms, cranes, etc. 38

Lamp Reflectors

FOSTORIA PRESSED STEEL CORPORATION, Fostoria, Ohio. Folder PS-5, descriptive of the "Para-Sphere" reflectors for infra-red lamps used in drying and baking operations. 39

Cranes

WHITING CORPORATION, Harvey, Ill. Sectional catalogue on Whiting cranes for machine shops, foundries, railroad shops, and all classes of industrial service. 40

Carburizing Furnaces

LEEDS & NORTHRUP CO., 4921 Stenton Ave., Philadelphia, Pa. Catalogue T-623, describing the Homocarb method for carburizing and the equipment employed. 41

Machine Tool Transmissions

WESTERN MFG. CO., 3428 Scotten Ave., Detroit, Mich. Circular descriptive of the Western line of transmissions for motorizing all types of machine tools. 42

Forged Tools

BILLINGS & SPENCER CO., Hartford, Conn. General catalogue (176 pages) covering the Billings line of forged tools. Wrench selection tables are included. 43

Arc-Welding Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y. Circular GES-2306, containing helpful information on welding and the proper selection of electrodes. 44

Dust Collectors

TORIT MFG. CO., 307 Walnut St., St. Paul, Minn. Bulletin descriptive of Torit dust collectors for carrying away dust from grinding, polishing, and buffing wheels. 45

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 143-154 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment mark with X in the squares below, the identifying number found at the end of each description on pages 143-154 — or write directly to the manufacturer, mentioning machine as described in March MACHINERY.

51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	
70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 138-139 mark with X in the squares below, the identifying number found at end of each description on pages 138-139 — or write directly to the manufacturer, mentioning name of material as described in March MACHINERY.

201	202	203	204	205	206

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

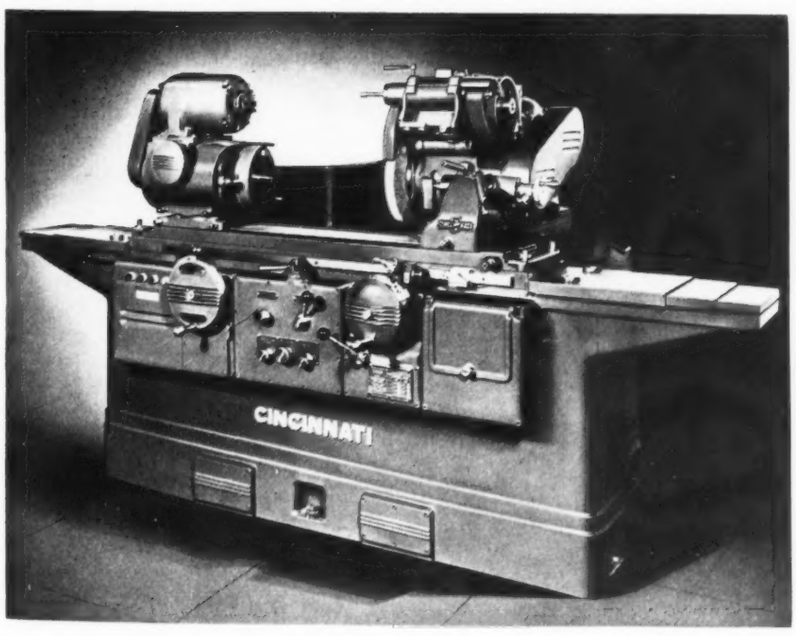
Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Cincinnati Hydraulic Universal Grinding Machine

A universal grinding machine embodying many new features developed for the rapid handling of precision grinding work has been brought out by Cincinnati Grinders Incorporated, Cincinnati, Ohio. This new machine has a swing of 12 inches, and is built with between-center lengths of 24, 36, 48, and 72 inches.

The wheel-head is equipped with the recently developed "Filmatic" spindle bearings of multiple-shoe construction. These bearings are steel-backed, bronze-lined, and self-adjusting for variations in load resulting from heavy or light cuts, and they run completely submerged in oil. A safety switch in the electrical circuit eliminates the possibility of operating the machine without an adequate supply of oil. A 3-H.P. motor mounted on top of the wheel-head unit drives the wheel-spindle.



Cincinnati Universal Grinding Machine Developed for the Rapid Handling of Precision Work

The table feed is actuated hydraulically from a circuit which supplies pressure on both sides of the piston. Feed rates are infinitely variable from 3 to 240 inches a minute. The table tarry at each end of the stroke can be independently adjusted from 0 to 5 seconds, while the accuracy of reversal at any table speed is within 0.004 inch. The power table traverse can be set for automatic reversal to give a reciprocating movement as short as 3/32 inch.

A new mechanical speed-changing device built into the headstock eliminates the need for a variable-speed direct-current motor, and provides an infinite number of work speeds from 55 to 500 R.P.M. The desired speed is obtained by rotating a small handwheel in front of the unit. The headstock can be swiveled at right angles to the grinding wheel for face-grinding operations, and is equipped with the necessary mechanism for changing quickly from live- to dead-spindle operation.

Automatic control of the work rotation and coolant flow may be cut out by means of a selector valve to permit hand control for convenience

To obtain additional information on equipment described on this page, see lower part of page 142.

in setting up. An internal grinding attachment hinged to the front of the wheel-head, where it is always in place ready for use, is included as regular equipment. The table has two hand-controlled traverse rates—a fast movement of 15/16 inch per revolution of the handwheel for setting up, and a slow movement of 0.050 inch per revolution of the handwheel for fine adjustments and shoulder grinding.

Mechanical hand traverse is regularly supplied, but hand hydraulic table control can be easily substituted. The hand-feed traverse of the wheel-head also has two speeds, moving at a rate of 1/4 inch per revolution of the handwheel in high gear, and 0.050 inch per revolution of the handwheel in low gear. For accurate sizing, the device can be adjusted in increments of 0.0001 inch reduction of work diameter. Automatic in-feed at table reversal can be adjusted from 0.0004 to 0.014 inch.

The table ways are pressure-lubricated with filtered oil, and are protected by telescopic guards. Unit construction is employed throughout, so that any unit can be dismantled without affecting the others. The weight of the machine varies from 5700 to 7900 pounds, depending on the length. 51

Wicaco Heavy-Duty Oil-Grooving Machine

The Wicaco Machine Corporation, Stenton Ave. and Louden St., Philadelphia, Pa., is now building a heavy-duty horizontal oil-grooving machine with a capacity for cutting oil-grooves of any length up to 22 inches in work 20 inches in diameter. The bushing or work to be oil-grooved is held rigidly in a non-revolving chuck. As the chuck remains stationary, machine members of unusual shape or size can be held in place for either internal or external oil-grooving operations, the standard chuck being removed, when necessary, and replaced with a fixture of special design.

The principal advantages of this automatic machine are obtained by features incorporated in the reciprocating tool-head and by the efficient grouping of the controls for easy operation. The reciprocating and the rotating tool speeds can be varied independently by means of change-gears to produce grooves of any desired predetermined lead or pitch.

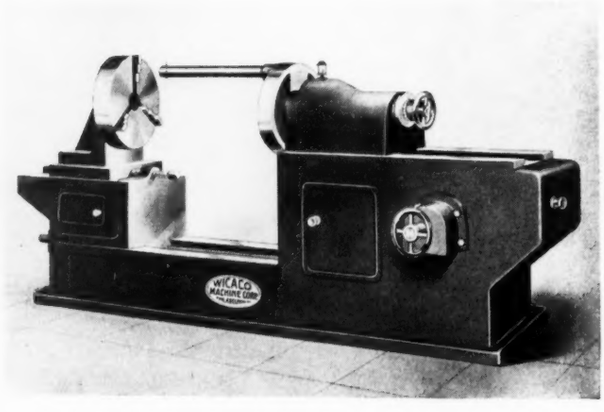
The feed for depth of cut is entirely automatic, the machine being pre-set to remove any desired amount of stock per cut, or the feed can be changed while the machine is in operation. The crank motion for reciprocating the tool-head can also be adjusted while the machine is running. The eccentric speed can be varied through change-gears, and the length of the oil-groove can be changed by adjusting the throw of the eccentric crank.

A cam arrangement in the machine base controls the knock-out or relieving attachment and permits the tool to be so controlled that the oil-groove can be cut half way, quarter way or any predetermined distance around the circumference of the work. As all parts of the machine operate independently and at variable speeds, practically any kind of oil-groove can be cut. A straight groove or an internal or external keyway can be produced by disengaging the rotary motion clutch. The entire mechanism is driven by a 3-H.P. motor built into the base of the machine. 52

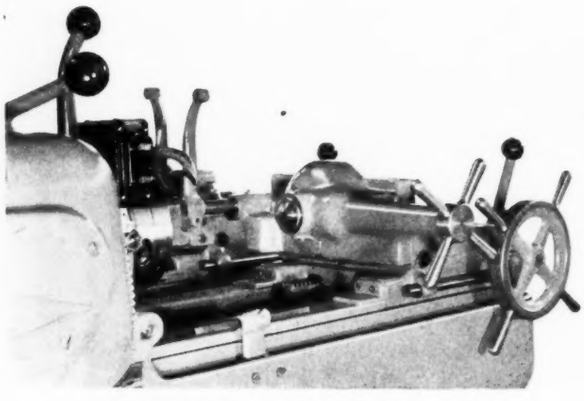
Collet Chuck Carriage Front for Landis Threading Machines

The Landis Machine Co., Inc., Waynesboro, Pa., has developed a new type of carriage front for use on either its Landmaco or Landis standard threading machines. This equipment is provided with a collet holding device of the type usually employed on automatic screw machines. The collet chuck is actuated by a handwheel that occupies approximately the same position as the handwheel of the standard carriage front. This arrangement enables the operator to accustom himself to the new type of chuck in the shortest time possible. The separate collets employed for each diameter of work can be easily interchanged by merely rotating the handwheel a few turns to release the collet on the machine, so that another one of the desired size can be quickly substituted.

Outstanding advantages of this new equipment include provision for holding work rigidly in alignment with the die-head to insure concentric threads, the elimination of gripper markings on the work, and construction that permits long pieces to be passed entirely through the collet. A stop can be employed to position the work with relation to the die-head, while very short pieces can be accurately positioned by an adjustable stop located within the bore of the collet. 53

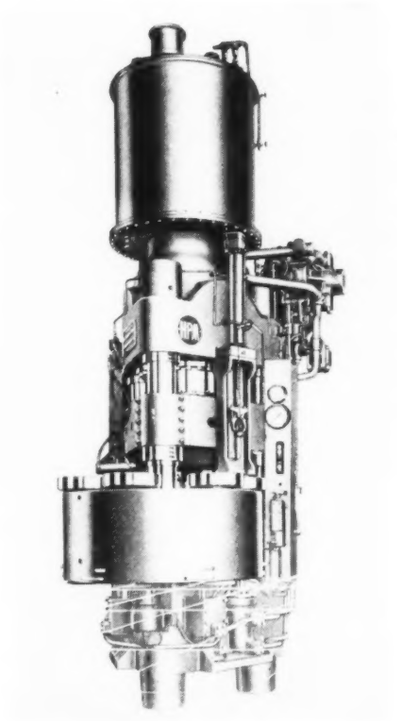


Wicaco Heavy-duty Oil-grooving Machine for Both Internal and External Work



Collet Chuck Carriage Front for Threading Machine Built by the Landis Machine Co.

To obtain additional information on equipment described on this page, see lower part of page 142.



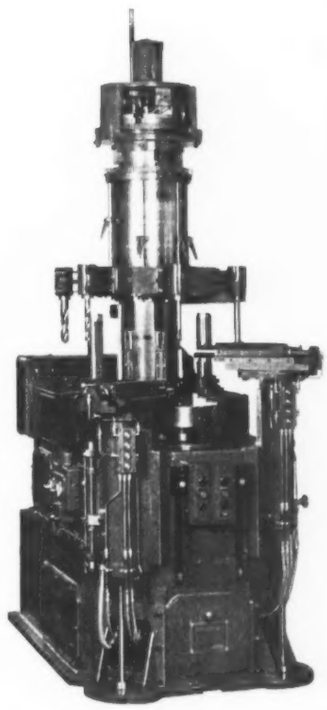
Cartridge-case Heading Press Built by the Hydraulic Press Mfg. Co.

H-P-M Turret Type Cartridge-Case Heading Press

The turret type cartridge-case heading press recently brought out by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, is available in maximum capacity ratings of from 550 to 3000 tons to accommodate shells ranging from 37 to 155 millimeters. The presses are equipped with the "Hydro-Power" closed-circuit operating system, the oil used as a pressure medium also serving as a lubricating agent. Fast movement of the press platen to and from the work is accomplished by an H-P-M "Fastraverse" arrangement. Hydraulic pressure for all the hydraulic rams is generated by a single "Hydro-Power" radial pump, a 40-H.P. motor being required to drive the pump on the 550-ton press, while all larger sizes require a 100-H.P. motor.

The frame and operating system are of the usual H-P-M design, except that three strain-rods are employed instead of four. This arrangement permits a six-station turret to revolve clockwise around one of the rods, so that the pressing station is directly beneath the pressure ram. With one station beneath the ram for heading, the stations on either side can be used as work stations. The station preceding the heading position can be used for indenting by placing the indenting tool on the main platen. The station directly following the heading position is employed for ejecting the work, while the remaining three stations which are outside of the press are employed for loading. Since time for loading and ejecting does not enter into the time cycle, production is increased from four to five times. The press platen is fitted with an air-operated sliding holder for two heading tools.

The cartridge cases are automatically ejected by a hydraulic ram. A manually operated air hoist with an automatic clamping fixture lifts the headed case clear of the turret. The press cycle is semi-automatic, the operator starting each complete cycle by pressing a button. The operator also controls the hoist while a helper removes the case and places another one in the empty turret station. 54



Verti-Hydra-Matic Chucking Machine with Turret and Two Side-heads

Verti-Hydra-Matic Chucking Machine

A new type, single-spindle, automatic chucking machine with a capacity for performing eight operations, designed for either short- or long-run production on work up to 16 inches in diameter, has been brought out by the Production Machinery Sales Co., 4845 St. Aubin Ave., Detroit, Mich. This automatically controlled machine, designated the "Verti-Hydra-Matic," occupies a floor space of only 48 by 66 inches, and is so arranged that one man can easily operate more than one machine. It has a rigid central column on which a six-faced turret is mounted, and two side-heads at the front of the machine, adjacent to a central chuck.

The turret reciprocates vertically on the column with a total travel of 14 inches, and is rotated by a selective indexing mechanism. The side-heads are equipped for 9-inch vertical and 3 1/2-inch horizontal movements. Their controls provide for rapid advance, feed, stop and dwell, and rapid return with the tool retracted.

With the exception of the turret indexing, which is effected by gearing, all movements of the turret and side-heads are obtained hydraulically through electrical controls. The chuck is gear-driven from a 5-H.P. motor in the base, which also drives the pump that supplies the hydraulic system. The spindle nose is 3 inches in diameter, hollow-bored to 1 1/2 inches, and threaded on the lower end for an air cylinder or other mechanical chucking device. The spindle has eighteen speeds ranging from 10 to 1775 R.P.M.

The electrical control for the turret and side-heads is located on top of the machine. The movement of the turret is selectively controlled for each face by adjustable contacts on the corresponding face of a control drum through rapid advance, coarse feed, fine feed, stop, dwell, rapid return, and index. A simple adjustment provides for indexing past one or more faces if desired. A duplicating device for the contour turning of shells and similar work is available, which can be used while grooving and inside machining operations are being performed. 55

Lincoln Stainless-Steel Electrode

A new stainless-steel electrode known as "Stainweld D" has been developed by the Lincoln Electric Co., Cleveland, Ohio, for use in arc-welding stainless steel of the 25 per cent chromium, 20 per cent nickel type, such as Iron and Steel Institute material No. 310. This electrode is also suitable for welding various stainless steels to mild steel and for

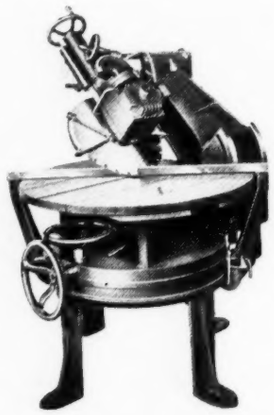
To obtain additional information on equipment described on this page, see lower part of page 142.

welding steels which are air-hardening and cannot be heat-treated after welding, such as armor plate. This electrode is made in five sizes, ranging from 3/32 to 1/4 inch, for welding at amperage ratings ranging from 30 to 225. 56

Radial Saw for Pattern and Woodworking Shops

The American Saw Mill Machinery Co., Hackettstown, N. J., has just brought out a radial saw known as the Uni-Point, for use in pattern and woodworking shops. An outstanding feature of this machine is its ingenious construction, which allows the saw to pivot both horizontally and vertically about one point in the center of the table. Regardless of whether the saw is tilted for cutting a 45-degree bevel or swung to a 45-degree compound miter angle, the bottom of the saw does not change its position with respect to the table. All cross-cuts, regardless of the angle, are accomplished without raising or lowering the saw blade, and any setting can be obtained instantly.

The over-arm of the machine telescopes when the saw is pushed back,



Uni-Point Senior Radial Saw

so that there are no projecting parts to interfere with the operator or his view of the work. The motor can be rotated so that the spindle is in a vertical position for routing, mortising, shaping, rabbetting, sanding, drilling, and other operations. This machine is made in two standard sizes — the "Junior," carrying motors up to 2 H.P. and saws up to 14 inches, and the "Senior," carrying motors up to 7 1/2 H.P. and saws up to 18 inches. 57

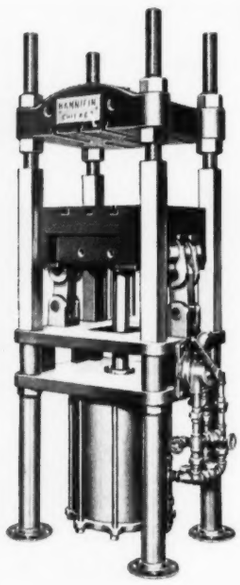
Hannifin Plastic Molding Press

A new plastic molding press has been developed by the Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago, Ill., in which special mechanical features have been incorporated to obtain better moldings with greater economy. The press illustrated develops a pressure of 50 tons when operated by air at a pressure of about 80 pounds per square inch. Higher air pressures can be used to increase the capacity to 70 tons.

The pressure developed through the combination lever and toggle mechanism is applied in a manner particularly suited for the compression molding of thermo-setting plastics. The platen advances rapidly, but decelerates when the dies begin to close, allowing time for the compound to soften, so that smoother and denser products are obtained. The rate of upward travel and the return speed are both adjustable to suit the application. The full tonnage capacity is applied in opening or "breaking" the mold.

If compressed air is not available, the press can be furnished with a completely self-contained hydraulic power unit. A variable delivery oil pump is used to maintain pressure during the curing period.

The height of the machine is approximately 7 feet, and the distance from the floor to the lower platen, when open, is 46 inches. The distance between columns is 22 inches, and the clearance between the platen and top strain-head 17 1/2 inches. The strain-head can be adjusted to permit a maximum daylight space of 29 1/2 inches. The platen stroke is 8 inches. Provision is made for the application of ejector-pins or a separate ejector-cylinder. The press occupies less than 5 square feet of floor space. A press similar to the one illustrated is also made by the same company in a 15-ton model. 58

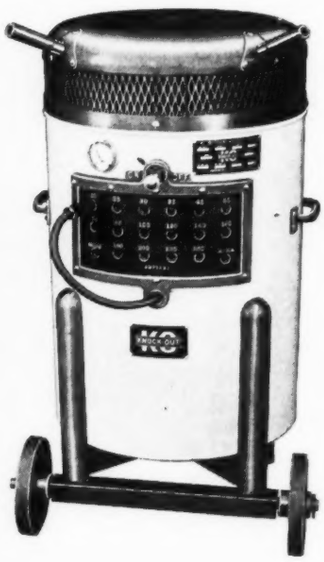


Hannifin 50-ton Plastic Molding Press

K. O. Lee Arc Welders

A new line of arc welders consisting of three models of 150-, 200-, and 250-ampere capacities has been brought out by K. O. Lee & Son Co., Aberdeen, S. D. These welders have a round streamline case with an oval dome and open ventilation at the top. The number of heat taps on the 200-ampere model have been increased from 10 to 14, and on the 250-ampere model from 10 to 16.

The cooling air enters through the open bottom and is unimpeded in its upward movement, as a larger open area is allowed at the top than at the bottom. A voltmeter can be furnished with all models. A two-wheel hand truck attachment is available for transporting the welders from one part of the shop to another, but the welders are regularly supplied with four casters. 59



Improved Arc Welder Brought out by K. O. Lee & Son Co.

To obtain additional information on equipment described on this page, see lower part of page 142.

Thomson Automatic Precision-controlled Press Welder

Thomson Press Welder with Indexing Table

A precision-controlled, high-production, automatic press welder equipped with an indexing work-table has been brought out by the Thomson-Gibb Electric Welding Co., 161 Pleasant St., Lynn, Mass. This special welder combines in one self-contained unit all the elements of a precision-controlled welder, with all the dials and switches requiring attention in a convenient position for observation and operation.

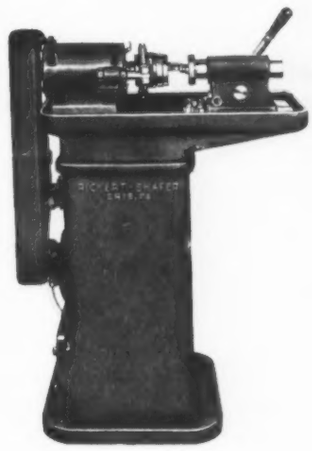
When the motor of this machine has been started, and any necessary timing, heat, or pressure adjustments have been made, the operator only has to keep his foot on the floor push-button and tend the rotary work fixture. The fixture has eight stations which automatically index into the welding position, where the work is clamped by a slide which engages an arm operated by an air cylinder. After being welded, the work is partly ejected from the dies and is readily removed by the operator. Two welds are made on each part at every stroke of the press.

The normal throat depth of the machine is 12 inches, and the stroke of the upper fixture is 2 inches. Speeds of from 8 to 24 strokes per minute and pressures up to 3500 pounds are available. Pressures are obtained from a power-driven cam acting through a toggle mechanism with an air-locked cylinder arranged to cushion the electrodes as they make contact with the work. 60

Rickert-Shafer Motor-Driven Threading Machine

A new horizontal hand threading and tapping machine of compact design is being introduced on the market by the Rickert-Shafer Co., 642 W. 11th St., Erie, Pa., for use wherever a variety of "second-operation" threading and tapping jobs are handled on work up to 3/4 inch in diameter. This machine is motor-driven through a three-speed V-belt, and has an oil pump and reservoir.

The R & S Model C self-opening die-head mounted on the ball-bearing spindle is automatically closed on the backward movement of the operating lever. The R & S Model C collapsible tap can be used for tapping, being reset by the same backward movement of the operating lever.



Motor-driven Threading Machine Made by the Rickert-Shafer Co.

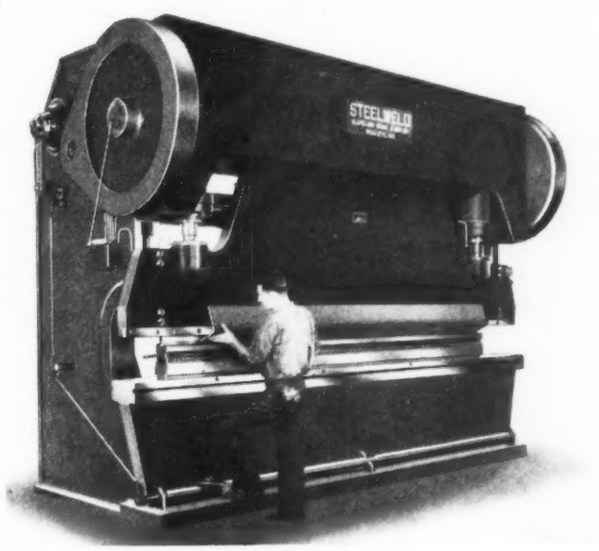
Work-holders designed for a great variety of production threading operations on work of irregular shape, as well as collet type holders for round stock, are available. 61

Steelweld Bending Presses

The Steelweld Machinery Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, has recently added a Model J-12 to its line of bending presses. This new press will handle plate material up to 12 feet by 5/16 inch between the housings, and up to 14 feet over the total length of bed and ram. Longer plates can be handled by extending the bed and ram, either on one or both ends, as shown in the illustration. Like the other Steelweld presses, the new machine has a one-piece all-welded frame.

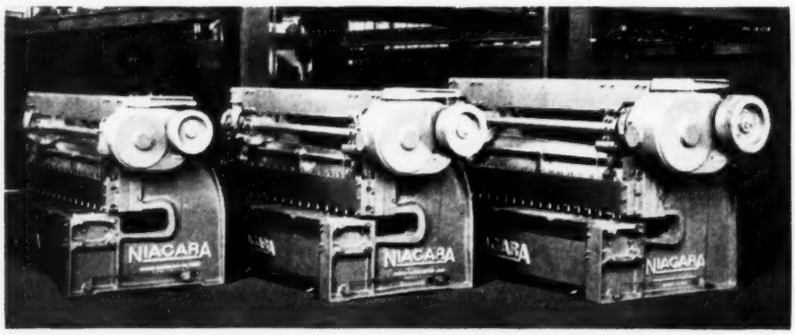
The ram is operated by two eccentrics, one on each side of the machine. Each eccentric is provided with three large main bearings and an eccentric bearing. The bearings of the press are automatically lubricated by two oiling units. All gears are protected with metal covers, and the shafts are located at the rear of the machine to prevent them from being damaged by crane hooks and bent-up plates.

This press can be used for bending, forming, blanking, drawing, rubber-forming, and multiple punching operations. Several operations can be performed by passing the work successively through various dies positioned along the length of the machine. The approximate over-all dimensions are: Length, 15 feet 6 inches; depth, 7 feet 4 inches; and height 11 feet. The throat depth is 18 inches, the same as on the other Steelweld presses. 62



Steelweld Bending Press with Frame of One-piece All-welded Construction

To obtain additional information on equipment described on this page, see lower part of page 142.



Niagara Power Squaring Shears Built in Various Sizes

Niagara Power Squaring Shears

The Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y., has developed a new series of power squaring shears in capacities ranging from 10-gage to 1/2 inch. More convenient arrangement of the controls and gages, full visibility of the cutting line, a quick-acting sleeve clutch, accessibility, and higher operating speeds are features combined in these new machines to increase their production capacities.

The new ball-bearing, self-measuring, parallel back gage, reading in increments of 1/128 inch, permits rapid and accurate adjustment. Each turn of the handwheel is equal to 1/4 inch of gage-bar travel. A stainless-steel scale on the gage bracket indicates the position of the gage-bar to the nearest 1/4 inch, and the operating handwheel is equipped with a dial that indicates the gage position to the nearest 1/64 inch. A plunger type of indexing handle engages locking holes for each 1/128 inch of gage-bar travel. The gage can be rapidly adjusted for taper-cutting. A separate dial indicates the relative position of the gage at the right-hand bracket for the non-parallel position. Recessed hand-grooves facilitate the safe handling of sheets on the working surface of the bed. Full-length T-slots provide for quick attachment and adjustment of side, bevel, and front gages.

The drive mechanism, including the 14-point sleeve clutch with built-in single-stroke mechanism, and all gears, are enclosed in an oil-tight case. The single-stroke mechanism can be disconnected to permit continuous operation. The clutch and gears operate in a bath of oil. The V-belt drive is regular equipment. 63

Greenerd Straightening Blocks and 6-Ton Hydraulic Press

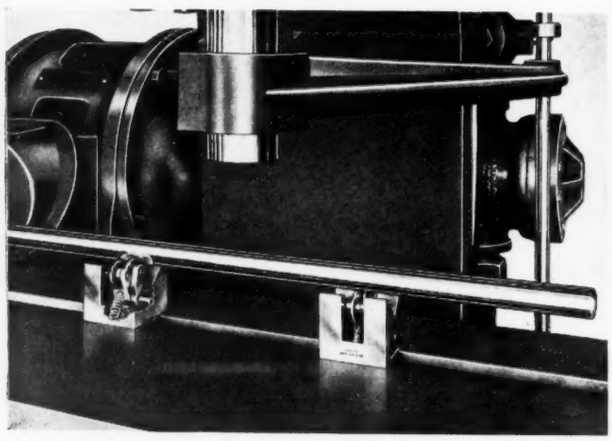
The Greenerd Arbor Press Co., 41 Crown St., Nashua, N. H., has developed a line of straightening blocks designed to speed up straightening operations on round shafts that are either turned or ground. This equipment is especially adapted for straightening motor shafts, spindles, and tubing. The shaft, when placed on the straightening block, is supported by two sets of hardened rolls. In this position the operator can spin the shaft to locate the high spots either with a piece of chalk or a dial gage. Then without removing the work from the blocks, the arbor press is employed to apply pressure to the work. This causes the rolls, which are mounted on swinging arms, to recede until the work is supported by the two steel vees for straightening. These straightening blocks are furnished in three sizes to accommodate shafts ranging from 1/2 inch to 3 inches in diameter.

This company has also added a 6-ton hydraulic press to its line of press equipment, which is designated as the No. H-57. The pressure control of this self-contained press ranges from 1/2 to 6 tons on the downward stroke. The stroke of the ram can be adjusted from 1 to 16 inches. 64

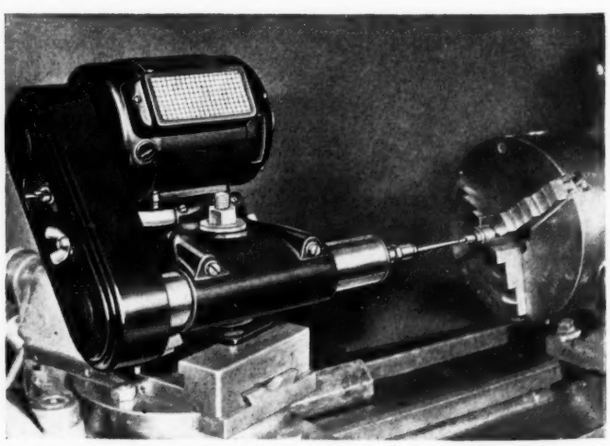
Dumore Mounted-Wheel Shank Support

A mounted-wheel shank support for internal grinding with small-diameter wheels has been developed by the Dumore Co., Racine, Wis. This support has been designed especially for grinding small-diameter holes to a considerable depth, using a special wheel shank 3 inches long as shown in the illustration.

The tapered support slips over the wheel shank, minimizing the possibility of "whip" caused by weak shanks bending under the pressure exerted by the wheel on the work. The support strengthens the shank sufficiently to permit deeper cuts.



Greenerd Straightening Blocks with Receding Rolls



Dumore Grinder Equipped with Wheel Shank Support

To obtain additional information on equipment described on this page, see lower part of page 142.

The shank of this support is 2 11/16 inches long, about 1/4 inch in diameter at its larger end, and has a taper of 3/8 inch per foot. 65

General Electric Radiation Type Thermo-Couple

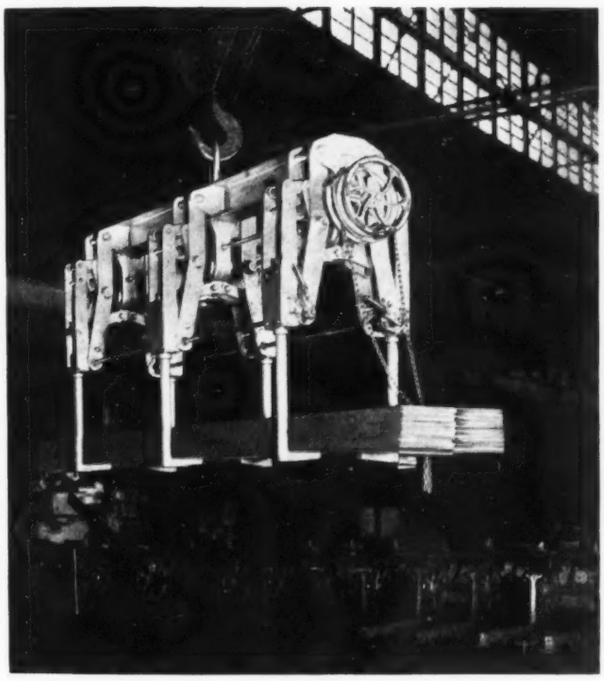
A new radiation type vacuum thermo-couple for more accurate furnace control, which is intended for use where exceptionally high sensitivity and rapid response are needed, has been brought out by the General Electric Co., Schenectady, N. Y. This thermo-couple was developed to meet the specific need created by the use of controlled protective atmosphere furnaces for processing materials at high temperatures. Among the applications are temperature measurement and control in brazing and heat-treating furnaces and in glass heat-treating.

The device may be mounted either temporarily or permanently on the furnace, the only accessory needed being a closed-end tube in the furnace. Since the thermo-couple itself has no physical contact with the high temperature furnace parts, it will not be damaged by the high temperature. The range of the instrument is from 575 to 2700 degrees F., but higher temperatures can be handled by using protective screens. 66

Cullen-Friestedt Sheet-Steel Lifter

A lifter for sheet steel, developed especially for handling two packs of narrow sheets side by side, has been brought out by the Cullen-Friestedt Co., 1305 S. Kilbourn Ave., Chicago, Ill. This design eliminates the danger of damaging the edges of the material and allows closer piling in storage and in loading cars. The lifter can also be used to handle any single bundles within its minimum and maximum opening range.

In operation the lifter is lowered over the bundles with a minimum of space between them and with the lifting prongs positioned parallel to the length of the sheets. When lowered to the proper level, the prongs are swiveled 90 degrees to bring them under the packs to be lifted. A few turns of the handwheel or chain wheel close the lifter to a position where the vertical legs are in contact with the sides of the bundles or packs and in the proper position for lifting. 67



Cullen-Friestedt Sheet-steel Lifter of 7-ton Capacity that Handles Packs up to 30 Inches in Width

Equipment Built by Progressive Welder Co. for Assembling Automobile Moldings by Spot-welding

Spot-Welding Equipment for Assembling Automobile Garnish Molding

The Progressive Welder Co., 717 Piquette Ave., Detroit, Mich., has developed a combination short-circuiting welding gun and clamping fixture for making spot-welds in locations usually difficult to reach. This new equipment is especially adapted for work such as found on automobile reveal and garnish molding, where intricately shaped, thin-section welding points could not stand up under continued operation. The arrangement shown in the accompanying illustration is claimed to have more than tripled production on work of this kind.

The welder has an enclosed transformer that is short coupled to bus-bars which also serve as nesting dies for the work. The single hydraulically operated spot-welding gun of the short-circuiting type is used alternately by two operators.

In performing the welding operation, the window reveal member is first secured against the bus-bar die by means of thumb-clamps. The garnish molding is then placed in position over the nesting die and is forced securely over the reveal member by tightening the hand-clamp.

The gun used is of the pincher type, pressure being supplied by a hydraulic pressure booster. The tip of the upper electrode has a relatively thin section, designed to permit it to enter the concave side of the garnish molding. 68

To obtain additional information on equipment described on this page, see lower part of page 142.

Denison Hydraulic Straightening and Forcing Press

A vertical hydraulic press built in 25- and 50-ton capacities for straightening and similar pressing operations has been added to the line of presses built by the Denison Engineering Co., 102 W. Chestnut St., Columbus, Ohio. The all electric-welded frame of the press is fabricated of steel plate, and has all corners and edges rounded.

The cylinder is flange-mounted in the upper portion of the C-frame, and the motor and pump compartment is enclosed by louvred panels. The entire rear panel of the press frame is removable, so that all parts are accessible for maintenance or adjustment.

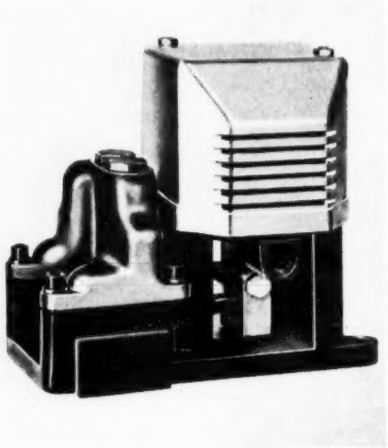
A slot extending lengthwise of the work-table provides for positioning dies or fixtures. The ram is guided and prevented from rotating by machined guides in the throat of the press. The end of the ram is tapped to receive holding tools or fixtures. Operating the foot-pedal or hand-lever causes the ram to move downward at a rapid rate until it comes in contact with the work. Further movement of either the hand-lever or foot-pedal causes greater pressure to be applied by the ram. Upon the release of the hand-lever or foot-pedal, the ram rises to its "up" position, as determined by the adjustment on the stroke control rod, the ram stops, and the pumps idle, consuming a minimum of power.

A pressure gage, reading in both pounds per square inch and tons, is located on the front of the press. The gage is equipped with a shut-off and can be used for setting up and checking the ram pressure. The maximum tonnage or pressure exerted by the ram can be adjusted from its full rated capacity in infinite steps to approximately 10 per cent of its working capacity. 69

Denison Hydraulic Press for Straightening and Forcing Operations

Ross Air Valve for Welding Equipment

The Ross Operating Valve Co., 6494 Epworth Blvd., Detroit, Mich., has just brought out a special model



Ross Air Valve for High-speed Operation of Welding Guns

solenoid-operated air valve designed to meet the demand for high-speed operation of welding guns. Although this valve has been operated at considerably higher speeds on experimental work, it is now regularly employed to deliver 400 welds a minute on production jobs. 70

Chambersburg Motor-Driven Pneumatic Forging Hammer

A new self-contained electro-pneumatic hammer designed for the economical forging of the tough carbon and alloy steels that have come into general use in recent years has been brought out by the Chambersburg Engineering Co., Chambersburg, Pa. The advantages gained by working forgings at high temperatures are obtained with these presses by means of the heavy anvil, high impact speeds, and exceptional rapidity of the hammer blows.

Chambersburg Pneumatic Forging Hammer

This pneumatic hammer is of the self-contained type, having a ram cylinder in which a compressor piston and a ram operate. The compressor piston is driven by a high-speed electric motor through two-stage speed reduction gearing.

The new hammer is made in three types. One type, built in two sizes rated at 200 and 300 pounds, is of one-piece design with the anvil integral with the frame. This type is intended for installations on shipboard or wherever deep foundations are impractical. Another type is built with a solid frame, separate anvils, and a one-piece frame of rigid reinforced construction. This type is made in sizes up to and including 500 pounds. The third type has a two-piece frame with separate anvils and with the frame rigidly mounted on a baseplate which encircles the anvil. This machine is made in sizes of 750 pounds and upward.

These hammers are so designed that the blows of the ram are accurately controlled with a minimum of effort either by hand-lever or foot-treadle. 71

Rectifier for Operating Small Magnetic Chucks and Motors

A convenient means for converting alternating current into direct current for operating five or six magnetic chucks of the kind commonly used in tool-rooms, or other direct-current equipment, is provided by the Model CR-6 rectifier placed on the market by the Mellaphone Corporation, Rochester, N. Y. This new rectifier has a direct-current output of 660 watts or 3/4 H.P. It will withstand a 100 per cent overload for five

To obtain additional information on equipment described on this page, see lower part of page 142.

minutes and is suitable for small motors using high starting current.

Two inexpensive mercury vapor type tubes are used for full wave rectification of single-phase alternating current. Alternating- and direct-current connections are made on a terminal board inside the hinged cover. The rectifier is 7 1/2 by 5 1/2 by 16 1/2 inches. 72

Delta Improved Cut-Off Machine

An abrasive cut-off machine with a capacity for cutting off material up to 2 inches in diameter or pieces up to 2 by 6 inches has been brought out for sale in the low-price range by the Delta Mfg. Co., 617 E. Vienna Ave., Milwaukee, Wis. This machine is designed to cut quickly and accurately, to exact lengths, such materials as steel, brass, copper, cast iron, Monel metal, plastics, pipe, Stellite, tool steel, manganese steel, brake linings, tile, brick, carbon, hard rubber, sand cores, etc. Metal pieces cut off on this machine have polished surfaces and require no finishing operations. By substituting a saw-blade, the same unit can be employed for cutting wood.

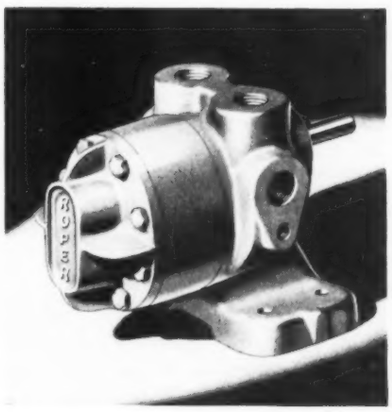
Some of the outstanding features of this machine are: Timken roller bearings and double-arbor sealed bearings that require no lubrication; Tex-Rope V-belt drive; adjustable fence; and accurately machined table. The machine can be used to cut material at any angle, and is equipped with safety features such as chip, belt, and wheel guards. 73

Roper Rotary Pumps

A new line of rotary pumps has just been introduced to the trade by the Geo. D. Roper Corporation, Rockford, Ill. This new line includes sixteen different sizes, with capacities ranging from 1 to 100 gallons per minute at speeds up to 1800 R.P.M. and against pressures up to 1000 pounds per square inch.

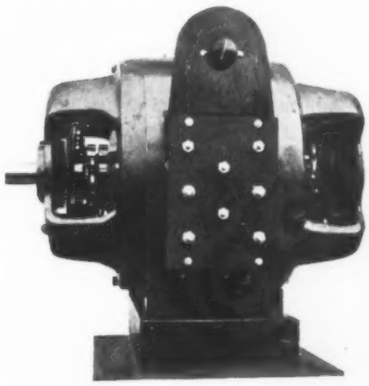
At present, twenty-one different drives and mountings are available, ranging from ordinary foot, hub, and flange mounting heads to complete bedplate units for direct motor drive, gear reduction, and flat or vee belt drive.

The "hydraulic balance" feature



Rotary Pump Made by the Geo. D. Roper Corporation

of these pumps equalizes internal pressure at all points and absorbs all shock or thrust from the power end of the drive-shaft. 74



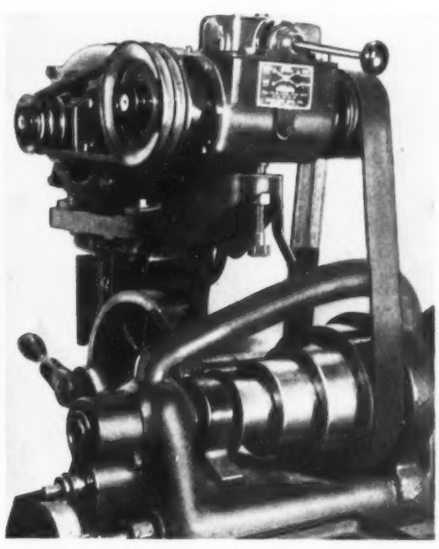
Katolight Direct-current Motor with 60-cycle Alternating-current Take-off

Direct-Current Motor Designed to Furnish Alternating Current

The Kato Engineering Co., 530 N. Front St., Mankato, Minn., has designed a line of direct-current motors that, in addition to driving equipment, also furnish alternating current for operating relays, fluorescent lamps, etc. For example, spot-welding transformers require alternating current, and when such transformers are used in direct-current areas, it is necessary to secure an alternating-current supply. This line of special direct-current motors is designed to solve such problems for manufacturers located in areas supplied only with direct current.

An interesting application of this special direct-current motor is on the Doall contour shaping machine manufactured by Continental Machines, Inc., Minneapolis, Minn., and which was described in October, 1939, MACHINERY, page 118. When this machine is supplied to customers where only direct current is available, it is equipped with a Katolight direct-current main drive motor. This motor furnishes the alternating current required to operate the butt welder provided for joining the saw ends. 75

Delta Abrasive Cut-off Machine

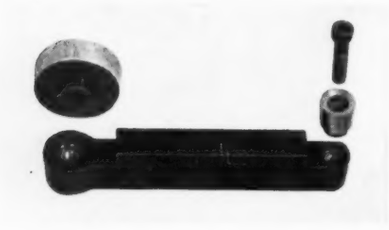


Western Master Transmission Applied to Tool-room Lathe

Western Machine Tool Transmissions

The Western Mfg. Co., 3428 Scotten Ave., Detroit, Mich., has developed a complete line of transmissions for motorizing all types of machine tools, including bolt-cutters, boring mills, die-sinkers, rotary drills, gear-cutters, lathes, milling machines, planers, screw machines, shapers, slotters, turret lathes, and

To obtain additional information on equipment described on this page, see lower part of page 142.



Radius Forming Tools and Holder Made by Forest City Bit & Tool Co.

other machine tools that require a motor-driven, self-contained, selective speed transmission unit.

This unit provides four speed changes forward and reverse, obtained with one conveniently located shifting lever of the automotive type. It is regularly made in two sizes. The "Master" is intended for machines requiring 1- to 5-H.P. motors, while the "Major" is designed for machines requiring 5- to 10-H.P. motors. 76

Velox Speed Indicator

A high-speed chronometric hand tachometer for indicating speeds up to 100,000 R.P.M. has just been brought out by Herman H. Sticht & Co., 27 Park Place, New York City. This speed indicator is designed for use in factories doing high-speed grinding and using the latest high-speed cutting tools, such as are employed in the manufacture of tools, roller bearings, automobiles, etc.

In using this indicator, the rubber point is applied as near the exact center of the rotating shaft as possible, so that the indicator spindle will revolve at the same speed as the shaft. A small lever at the left of the dial is then pressed and allowed to fly back to its original position. This resets the indicator to zero and winds and starts the chronometer movement. After approximately 1 1/2 seconds, the spindle is automatically coupled to the counting mechanism, and it is uncoupled from it after exactly six seconds have elapsed. The hands are stopped automatically. The instrument has thus counted the revolutions during six seconds, but the scale is calibrated to ten times this value, so that the number of revolutions per minute can be read directly from the dial. 77

Forest City Radius Forming Tools

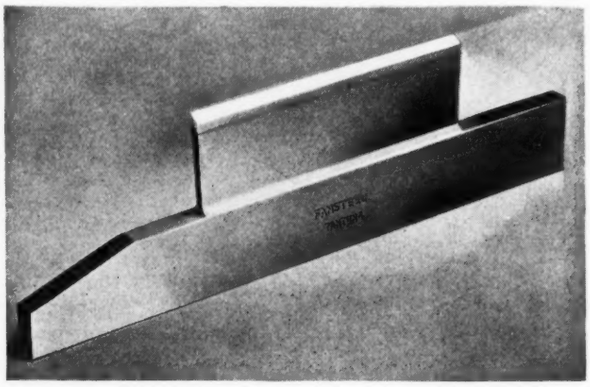
A complete set of eight radius turning tools, a holder and wrenches, conveniently fitted into a wooden block, has been brought out by the Forest City Bit & Tool Co., Rockford, Ill. This new equipment is especially adapted for tool-room use on lathes, shapers, and planers. The hub of the circular tool is designed for strength and it permits adjustments without disturbing the work after the tool is set up.

The circular design of the radius cutter assures long life, as the entire circular tool can be used for cutting. The eight tools cover radii ranging from 5/16 to 3/4 inch. The holder is 5/8 by 1 1/4 inches with an overall length of 5 7/16 inches. 78

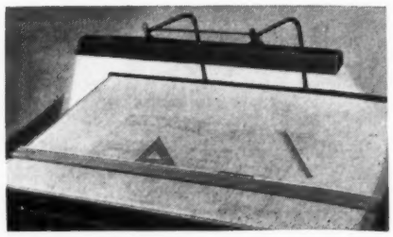
Fansteel Centerless Grinder Blades

Centerless grinder blades, or rests, faced with a tough, wear-resisting alloy known as Tantung, are obtainable from the Fansteel Metallurgical Corporation, North Chicago, Ill., for use on any type of centerless grinding machine. The tantalum in the hard facing material not only contributes to its hardness, but also imparts a lubricating characteristic that improves resistance to wear.

The Tantung facing, which is made in bar form, is firmly affixed to the steel supports by a special brazing process. Complete blades are manufactured to specifications, but the facing can be applied to existing blades as well. Tantung bars can also be furnished to companies equipped to do their own brazing. Worn-out blades can be reclaimed by applying new facings, and when the Tantung facing finally wears out, a new facing can be applied. 79



Tantung-faced Centerless Grinder Blades



Fluorescent Drafting-table Light Made by Hamilton Mfg. Co.

Fluorescent Drafting-Table Light

A new type of drafting-table light which uses a fluorescent bulb designed to provide lighting as near natural north light as possible, has been brought out by the Hamilton Mfg. Co., Two Rivers, Wis. It is claimed that colors can be matched as accurately as by daylight under this light. The cool light furnished by the fluorescent bulb adds to the worker's comfort, and it is said to be much easier on the eyes because it produces a minimum of glare.

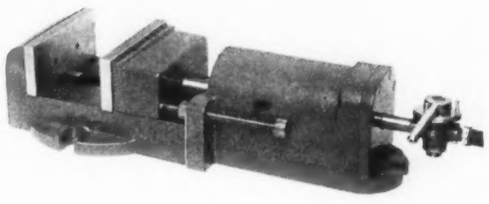
The light is built into a 44-inch long reflector so that the entire drafting-board surface receives proper lighting, 100 foot-candles of light being provided directly under the bulb and not less than 50 foot-candles at the extreme edges of the board.

A trough on the edge of the reflector may be used for pencils, triangles, etc. The light can be furnished for use on either alternating or direct current. 80

"Instant Heat" Electric Solderer

A new solderer that is especially designed for all kinds of light soldering is being placed on the market by the Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill. This solderer is designated the "Instant Heat," because it heats instantly upon touching the wire or terminal to be soldered. Being little larger than a lead pencil, it can be used in places that are relatively inaccessible. The heating stops instantly upon withdrawing the carbons from the wire or terminal. The line current is reduced by a transformer to a harmless low voltage. 81

To obtain additional information on equipment described on this page, see lower part of page 142.



Larkin Air-operated Vise for Use in Machine Shops and Tool-rooms

Larkin Air-Operated Vise

A pneumatically operated vise designed for production machine work is now being made by the Larkin Air Vise Co., Portland, Conn. It is claimed that pneumatic operation of the vise makes possible a considerable saving in production time, particularly when operations are short and many pieces are machined with one set-up. The vise is equally well adapted for bench work, milling, shaping, planing, drilling, and other machine shop and tool-room operations.

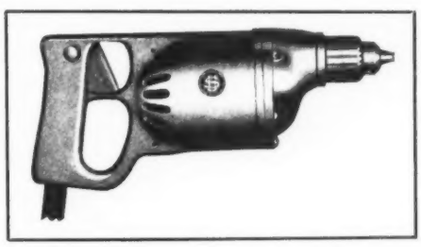
This vise is available in five sizes, ranging from 4 to 8 inches in jaw width, with maximum openings of from 3 1/4 to 5 inches. It is regularly supplied with hardened and ground jaws, flanged base, and hand-operated control valve. Special jaws to fit any work, swivel and universal bases, and foot-operated valves are also available. 82

Challenge Surface-Plate Equipment

The Challenge Machinery Co., Grand Haven, Mich., has recently placed on the market a line of accurate surface-plate equipment designed for use in inspection, lay-out, assembly, and similar types of operations, as well as for bench work. This surface-plate equipment consists of parallels in several sizes, V-blocks up to 6 by 8 by 8 inches, adjustable leveling blocks to compensate for odd dimensions, and a wide range of angle-plates for holding or clamping the work. Each unit is made from fine-grained iron, which is furnace-normalized to assure permanent accuracy. 83

G-E Gage for Checking Fillet Welds

A new fillet-weld gage has been developed by the General Electric Co., Schenectady, N. Y., to meet the need of welding inspectors and operators for a fast, accurate means of checking the size of fillet welds on jobs that are required to meet rigid specifications. The new device, which slides readily into the pocket, can be used on fillets of various sizes from 1/4 to 5/8 inch. Each fillet size is clearly marked in black on the gage. 84



Utility Drill Made by United States Electrical Tool Co.

Utility Drill of Streamline Design

The new 5/16-inch Utility drill recently added to the line of the United States Electrical Tool Co., Cincinnati, Ohio, is also made in a 5/8-inch size. This drill is equipped with ball bearings throughout, has a double-pole trigger switch with an automatic-release thumb-latch, and a three-jaw screw-back chuck. The universal motor operates on either direct or alternating current of 25 to 60 cycles. 85

Portable Electric Hammer with "Sling Shot Drive"

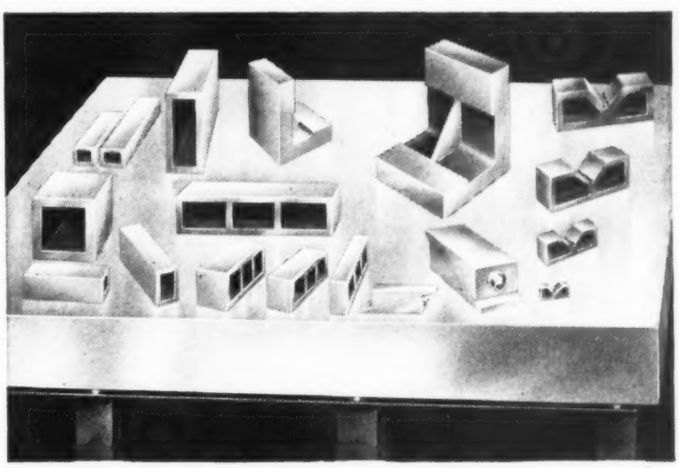
"Thor-Nado" Portable Electric Hammer

An electric hammer known as the "Thor-Nado," which has a radically new actuating mechanism termed the "sling shot drive" that delivers an exceptionally hard blow for a tool of its size and capacity, has been developed by the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. Although the tool is only 13 1/2 inches long and weighs but 14 pounds, it is adapted to a wide variety of heavy-duty applications, including drilling, channeling, chipping, cleaning, scaling, beading, caulking, and seaming.

The "sling shot drive" mechanism drives the piston by means of a shock-proof rubber connection. This drive whips the piston back and forth at a speed of 1600 blows per minute, acting as both power accumulator and shock absorber. There is no metal connection between the piston and the motor. 86

Co-Ro-Felt Pad for Disk Sanders

A new light-weight backing-up pad for disk sanders has recently been developed by the Columbian Rope Co., Auburn, N. Y. This pad is available in 7-, 8-, and 9-inch sizes. It has a molded plastic center. Both the center and the flexing surface are made of rope fiber, bonded and molded at the same time to prevent the two from separating. The pad can be used for sanding and polishing metal or wood surfaces. It is accurately balanced throughout to cut down vibration. The 7-inch pad weighs less than one-half pound. 87



Surface-plate Equipment Made by Challenge Machinery Co.

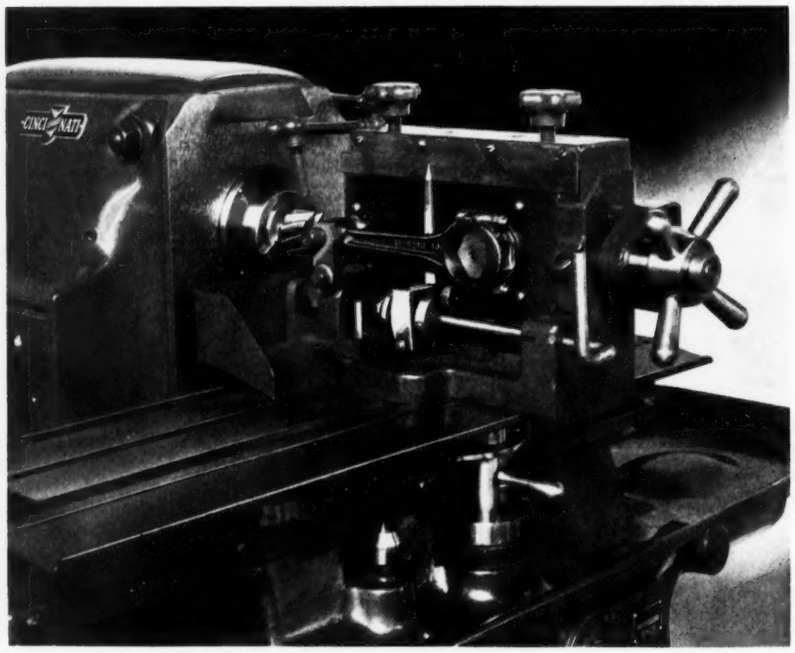
To obtain additional information on equipment described on this page, see lower part of page 142.

Limit Switch with Roller Actuator

The Micro Switch Corporation, Freeport, Ill., is placing on the market a new precision limit switch for actuation by rotating or sliding cams. It has a roller actuator that is adjustable through an arc of 225 degrees. The switching element consists of a single-pole micro switch with normally open or normally closed double-throw contact arrangements. It is resistant to oil and water, and is rated at 1/2 H.P. up to 460 volts alternating current. 88

Work-Holding Fixture with Weighing Device that Indicates Amount of Stock to be Milled Off

A milling operation in an automotive engine plant in Russia is shown in the accompanying illustration. This operation, which consists of milling the weight boss on the wrist-pin end of assembled connecting-rods and caps, is performed in a Cincinnati automatic milling machine. One of the features of this operation is the use of a work-holding fixture, in which is incorporated a special weighing device for determining the amount of stock to be milled off. This device indicates the proper endwise location of the forging. The rod is fed directly into an alternate-tooth milling cutter.



A Weight Correction Operation being Performed in a Milling Machine Equipped with a Work-holding Fixture in which a Weighing Unit is Incorporated

The rod and cap assembly is located horizontally on the work fixture from the finished bore in the wrist-pin end and a hexagonal plug which enters the crankpin bearing. About 1/8 inch of stock is milled off a 3/4-inch boss in the operation. Rod and cap assemblies are weighed and milled at the rate of 200 an hour.

Gear Production in January

The American Gear Manufacturers Association, 602 Shields Bldg., Wilkinsburg, Pa., announces that gear sales for January, 1940, were more than 35 per cent ahead of January last year, and approximately 11 per cent ahead of December, 1939. According to the statistics of the Association, the total volume of gear sales for 1939 was 36 per cent over 1938.

Photo-Electric Relays Pay for Themselves in One Day

A manufacturer of automobile parts experienced recurring trouble on a six-operation sequence press. A part would stick on the ram, the feeding mechanism would automatically place another piece under the ram, and when the ram came down on the two pieces, an expensive die would be damaged.

Seven years ago this manufacturer installed photo-electric equipment to prevent this damage. Six General Electric photo-electric relays were installed to stop the press before a second stroke, should any part stick on the ram. The contacts of the six relays were connected in series, so that in case of trouble at any point, a solenoid would trip the clutch of the press. As a further protection, the light sources were also series-connected, so that the failure of the light would also bring the machine to a stop. A push-button was so located that the operator could stop the machine at will.

During the first day of operation, the photo-electric relays stopped the press when a part stuck on the ram. The price of the protective equipment was only about one-half what it would have cost to repair the die, so that the equipment more than paid for itself in its first day of operation. For seven years it has saved the manufacturer $3000 a year in die maintenance costs, or a total saving of $21,000 thus far.

* * *

Honoring Inventors

On February 27, nineteen inventors and research workers selected from among more than one thousand nominees of the nation's outstanding creators of new products, new industries, and new jobs during the last quarter century, were paid national tribute at a Modern Pioneers dinner held at the Waldorf-Astoria Hotel, New York City, under the auspices of the National Association of Manufacturers. In addition, about five hundred inventors and research workers designated as Modern Pioneers were honored at celebrations held in local communities during the month of February—in Cleveland; Minneapolis; San Francisco; Detroit; Philadelphia; St. Louis; Baltimore; Rochester, N. Y.; Chicago; Boston; Hartford, Conn.; Los Angeles; Cincinnati; Birmingham; and New York.

To obtain additional information on equipment described on this page, see lower part of page 142.

NEWS OF THE INDUSTRY

Illinois and Indiana

WILLIAM A. BARR was elected president of Foote Bros. Gear and Machine Corporation, 5304 S. Western Blvd., Chicago, Ill., at a recent meeting of the board of directors. Upon the resignation

Moffett Studio

William A. Barr, New President of Foote Bros. Gear & Machine Corporation

of F. H. Fowler, formerly president, last November, Mr. Barr was elected executive vice-president and general manager. Previous to that he had been vice-president in charge of manufacturing for eight years. He first became associated with the corporation in 1929, as works manager.

CLEARING MACHINE CORPORATION, 6499 W. 65th St., Chicago, Ill., has just completed the company's fourth plant addition in six years. The new building adds approximately 10,000 square feet of floor space and extends the present plant to the east. The addition is of the same general construction as the main plant. It was necessitated by the expansion of the company's business.

H. H. YEAGER has been appointed assistant sales manager of the Shafer Bearing Corporation, 35 E. Wacker Drive, Chicago, Ill., manufacturer of Shafer radial thrust roller bearings. Mr. Yeager has been for a number of years district sales manager of the Dodge Mfg. Corporation, and prior to that held the position of manager of the mill supply department of S K F Industries, Inc.

AMERICAN MACHINE AND METALS, INC., East Moline, Ill., has established new district offices in Pittsburgh, Pa., and West Hartford, Conn., to handle the company's line of Riehle testing machines. R. A. ARMSTRONG will be in charge of the Pittsburgh office, and P. P. JOHNSTON will supervise sales in the New England area.

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill., have completed a large addition to their plant, consisting of a new all-steel building, 75 by 555 feet, which will increase the total floor space to over 650,000 square feet. The new building will be used for storing hot-rolled steel bars, shapes, and plates.

GEORGE G. HATHAWAY has been appointed sales manager of the International Machine Tool Co., Indianapolis, Ind. Mr. Hathaway was previously employed for eleven years with the Jones & Lamson Machine Co., Springfield, Vt.,

George G. Hathaway, Sales Manager International Machine Tool Co.

in the capacity of salesman in the Philadelphia territory and manager of the New York office. Before that, he was sales manager for four years with the Kingsbury Machine Tool Corporation, of Keene, N. H.

E. A. KINSEY CO., INC., Cincinnati, Ohio, sales agent for heavy-duty machine tools, as well as abrasives and safety equipment, announces that the Indianapolis branch of the company has been moved into a new building at 725 N. Capitol Ave., Indianapolis, which affords an office space of about 1250 square feet, and stock-room and shipping-room space of 7000 square feet.

Michigan

E. L. MCILHENNY has been appointed manager of the Alkali Division of the Detroit Rex Products Co., Detroit, Mich., manufacturer of Detrex degreasers, alkali washers and cleaners, and dry cleaning equipment. Mr. McIlhenny has been connected with the metal-cleaning industry for the last thirteen years.

WILLIAM JESSOP & SONS, INC., are opening a warehouse and sales office at 1024 W. Seven Mile Road, Detroit, Mich., where stocks of Jessop's Sheffield tool and die steels will be carried. E. R. S. REEDER is district sales manager in charge of the new office.

FARNHAM MFG. CO., 1646 Seneca St., Buffalo, N. Y., manufacturer of special machinery, has opened a new office at 618 McKerchey Bldg., Detroit, Mich., with THEO. M. JACOBOWITZ in charge.

LANDIS TOOL CO., Waynesboro, Pa., announces the removal of its Detroit office to 420 New Center Bldg., Detroit, Mich.

New England

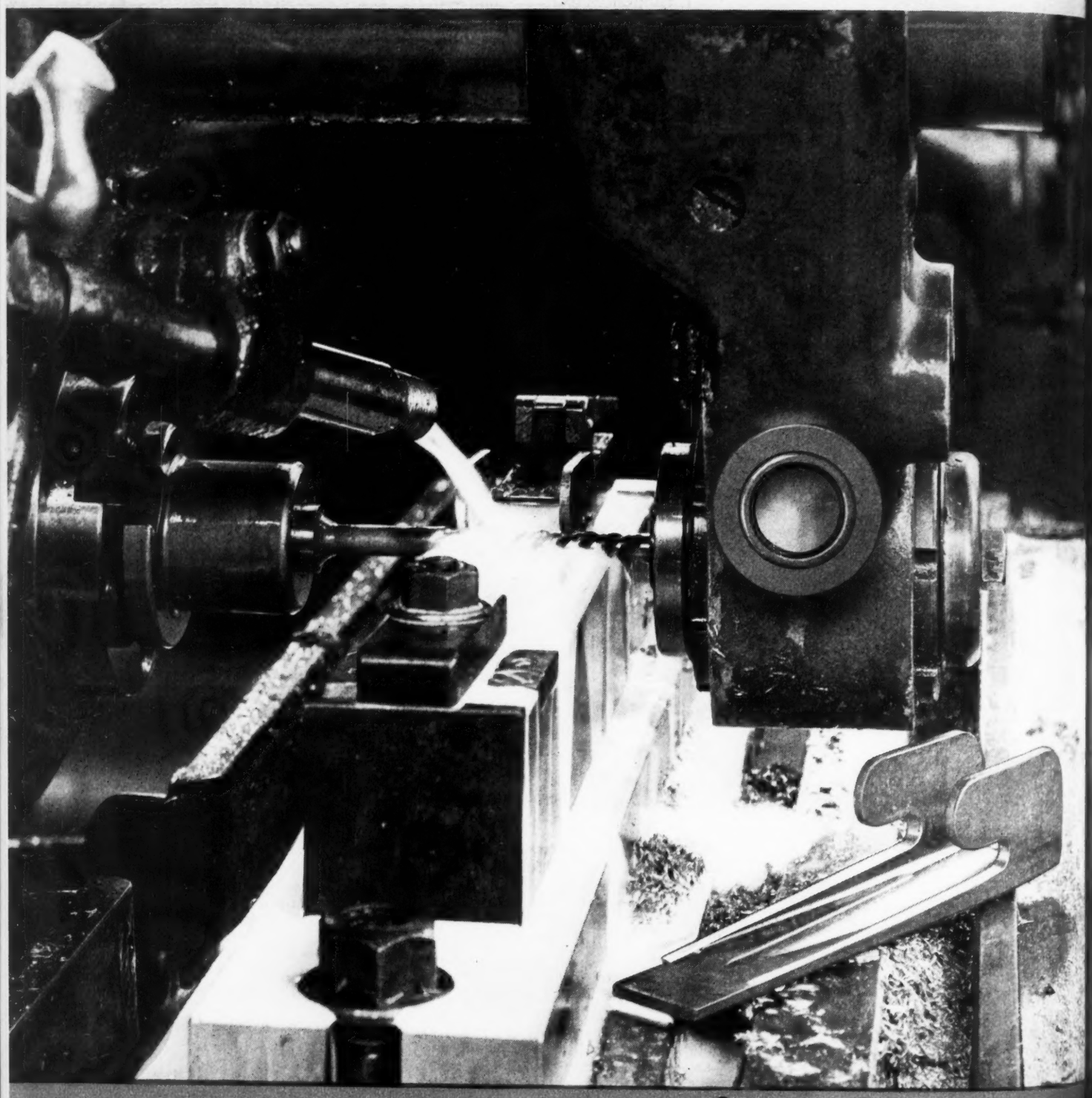
ALBERT F. BREITENSTEIN, chief engineer of the Geometric Tool Co., New Haven, Conn., was the recipient of one of the Modern Pioneer Awards at a dinner given in Hartford, Conn., on February 16. The award was sponsored by the National Association of Manufacturers in honor of the one hundred and fiftieth anniversary of the American patent system. Clayton R. Burt, president of Pratt & Whitney Division Niles-Bement-Pond Co., presided on the occasion. Mr. Breitenstein has been with the Geometric Tool Co. since 1903, and has forty-one patents to his credit, covering original designs and improvements in die and tap heads, means for measuring threads, fixtures for grinding thread chasers, and other devices.

FREDERICK G. HUGHES, general manager of the New Departure Division, General Motors Corporation, Bristol, Conn., was presented with one of the Modern Pioneer Awards under the auspices of the National Association of Manufacturers, at a dinner given in Hartford, Conn., on February 16. The recognition of Mr. Hughes as an outstanding inventor was the result of his patents on preloaded ball bearings and their applications. He was in immediate charge of the development of ball bearings during the most important pioneer period in the automotive industry, and also had much to do with their application in machine tools and farm implements.

F. H. BANBURY, of the Farrel-Birmingham Co., Ansonia, Conn., received one of the Modern Pioneer Awards sponsored by the National Association of

STOP OR REVERSE *ACCURATELY*

Another Advantage of



BROWN &

AT END OF CUT - - -

Electrical Control on Nos 10 and 12

Accurate tripping through Modern Electrical Control gives close timing of table functions . . . resulting in ability to mill to very close limits on blind cuts . . . and reducing non-cutting time to a minimum.

In addition, Brown & Sharpe Electrical Control is outstanding for —

Quiet and smooth operation

Simplicity and ease of set-up

Wide choice of operating cycles

Automatic reverse in cutting feed

Fast, safe control

In photo—a blind cut where accurate table reversal is essential—readily performed on either the No. 10 (shown) or No. 12 Plain Milling Machine. **Investigate** the possibilities of these profitable machines on **your** work. Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

B·S

— — Another Modern feature . . . . the Backlash Eliminator . . . . permits full advantage of Climb Milling

SHARPE

Manufacturers, at a dinner given in Hartford, Conn., February 16. He received this award for his invention of the Banbury mixer, which has revolutionized the mixing and compounding of rubber and plastic materials.

LAMINATED SHIM CO., INC., Long Island City, N. Y., manufacturer of shims and small stampings, has just started work on a new plant at Stamford, Conn. The new building is to be of one-story construction and will have a floor space of about 30,000 square feet. It is expected that the plant will be completed early in June.

JOHN S. ISDALE, 144 Curtis St., Meriden, Conn., is now representing the AJAX ELECTRIC CO., INC., Philadelphia, Pa., in the state of Connecticut.

NORTON CO., Worcester, Mass., announces the following changes in its sales organization for the Pacific Coast. P. S. WISWELL, who has been looking after the interests both of the Norton Co. and of the Behr-Manning Division of the company, will devote all his time to the sale of Behr-Manning products. WARREN H. TURNER, who has been field engineer in the Detroit area, will take over the southern California territory, with headquarters in Los Angeles. E. G. PETHERICK, formerly grinding wheel specialist for C. W. Marwedel, distributor of Norton products in San Francisco, will join the Norton organization, with headquarters in San Francisco, and take over the northern California district.

THURE L. F. LARSSON, mechanical engineer at the Norton Co., Worcester, Mass.; RAYMOND R. RIDGWAY, director of abrasive research, Norton Co., Chippawa, Ontario; and ELMER C. SCHACHT, vice-president of the Norton subsidiary, Behr-Manning Corporation, Troy, N. Y., have received the Modern Pioneer Awards sponsored by the National Association of Manufacturers. Mr. Larsson received his award at a dinner at the Copley-Plaza Hotel in Boston, February 20; Mr. Ridgway at a dinner held in Rochester, N. Y., February 19; and Mr. Schacht at a dinner held at the Waldorf-Astoria Hotel, New York City, February 27. Mr. Larsson has to his credit a great many inventions ranging from plunger elevators and elevator equipment to grinding wheel balancing devices and segmental grinding wheels. Mr. Ridgway received an award because of his researches and inventions in connection with the abrasive known as "Norbide" (boron carbide). This substance is the hardest material ever produced for commercial purposes, and is extensively used as a lapping powder to finish cemented-carbide tools and in the manufacture of wire-drawing dies, gage-blocks, etc. Mr. Schacht's inventions include the development of a new tvpe of gasket material which is water- and oil-resistant. Other inventions of his are a press blanket for printing cylinders, and insulated conductors.

New York and New Jersey

BAKELITE CORPORATION, Unit of Union Carbide and Carbon Corporation, New York City, held the first of a series of meetings on protective coatings for industry in the Lecture Hall of the Franklin Institute, Philadelphia, Pa., on January 30, with more than four hundred engineers and industrialists attending. The speakers were ARCHIE J. WEITH, of the company's Research and Development Laboratories; ARTHUR K. DOOLITTLE, director of surface coating research of the Carbide and Carbon Chemicals Corporation; and DR. ROBERT J. MOORE, of the Varnish Resin Division of the Bakelite Corporation.

RANSOME CONCRETE MACHINERY CO., Dunellen, N. J., has appointed the WELDING ENGINEERING SALES CORPORATION, 110 E. 42nd St., New York City, sales representative for its line of welding tables and positioners in the state of New York and part of New Jersey. The HAWAIIAN GAS PRODUCTS, LTD., Honolulu, Hawaii, have been appointed exclusive representatives for the same products in Hawaii.

HYDRAULIC PRESS MFG. CO., Mount Gilead, Ohio, has moved its New York office to 233 Broadway, where increased space and modern facilities make it possible to render a more complete service to its customers and prospects in the New York area.

AJAX FLEXIBLE COUPLING CO., Westfield, N. Y., has just completed the construction of an addition to its factory which will house the company's enlarged electric welding and assembling departments for the fabrication of Ajax vibrating screens, conveyors, etc.

THOMAS C. DELANEY, 215 Montague St., Brooklyn, N. Y., has been appointed foreign sales manager for the Ball and Roller Bearing Co., Danbury, Conn., manufacturer of precision bearings of both ball and roller types for industrial installations.

WORTHINGTON PUMP AND MACHINERY CORPORATION, Harrison, N. J., announces that its subsidiary, the MOORE STEAM TURBINE CORPORATION, Wellsville, N. Y., will be conducted in the future as the MOORE STEAM TURBINE DIVISION of the corporation.

PRECISION TOOL CO., has removed its executive offices from Bridgeport, Conn., to Brooklyn, N. Y. All correspondence should be addressed to P. O. Box 155, Brooklyn.

HANSON-VAN WINKLE-MUNNING CO., Matawan, N. J., manufacturer of electroplating equipment and supplies, has acquired the CONSOLIDATED BRUSH CORPORATION, 5 E. 17th St., New York City, manufacturer of a metal-hub brush for scratch-brushing operations. LEO J. SPRINGER, president of the latter corporation, has joined the Hanson-Van Winkle-Munning organization.

JOHN T. PHEATT, formerly advertising manager of The Certain-teed Products Co., New York City, has been appointed manager of advertising and sales promotion for the Walker-Turner Co., Inc., Plainfield, N. J.

North Carolina

TIDE WATER ASSOCIATED OIL CO. has opened a southern branch at 1122 South Blvd., Charlotte, N. C. R. H. MARINER is the new regional manager and W. H. YOUNG, JR., will assist him in a sales capacity.

Ohio

J. W. BERRIMAN, manager of the New York branch of the Timken Roller Bearing Co., Canton, Ohio, for the last seven years, has been given an indefinite leave of absence due to illness. His position is now being filled by H. C. SAUER, who has been transferred from the Chicago office, where he has served in a managerial capacity for nine years. L. J. HALDERMAN, who for the last ten years has been manager of the company's Kansas City branch, has been transferred to Chicago. F. A. WEISENBERGER, of the Pittsburgh sales force, will assume the managerial responsibilities of the Kansas City branch.

MONARCH MACHINE TOOL CO., Sidney, Ohio, recently honored twelve employes who have been with the company twenty-five years or more. The occasion marked the inauguration of the Monarch Quarter-Century Club. Those who have just completed twenty-five years with the company received gold wrist watches; those who have been with the firm more than twenty-five years received this token of esteem from the company when they completed their quarter century of service.

S. D. PARTRIDGE, formerly assistant manager of the Industrial Division of the Timken Roller Bearing Co., Canton, Ohio, has been appointed manager, and M. H. KUHL has been made assistant manager. P. J. REEVES, formerly manager of the Los Angeles office, has been transferred to the home office to engage in special sales work. He will be succeeded in Los Angeles by S. T. SALVAGE, who has previously been engaged in sales-engineering work for the company.

SIDNEY D. WILLIAMS has been appointed vice-president in charge of sales for the new Steel Division at Warren, Ohio, of the Copperweld Steel Co., Glassport, Pa. Mr. Williams was connected from 1926 to 1940 with the Timken Steel & Tube Division of the Timken Roller Bearing Co., Canton, Ohio.

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Pennsylvania

JOSEPH S. PECKER, well-known Philadelphia consulting engineer and head of the Machine & Tool Designing Co., 1011 Chestnut St., Philadelphia, Pa., received one of the Modern Pioneer Awards at a dinner given on February 16 at the Bellevue-Stratford Hotel in Philadelphia, under the auspices of the National Association of Manufacturers. Mr. Pecker, who is forty-six years old, has for many years been a pioneer in the field of mechanical engineering, and among his many achievements are those made in connection with the Autogiro. He has many other inventions to his credit. With Henry A. Simpson, he was responsible for animating the 40,000 miniature automobiles and trucks in the General Motors' "Futurama" at the New York World's Fair.

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill., have recently completed an addition to their steel-service plant in Philadelphia which increases the total floor space by approximately 250,000 square feet. Two new buildings have been erected, one, 185 by 120 feet, for storing structural lines such as beams, angles, etc., and the other a heated building with a floor space of more than 20,000 square feet for storing cold-finished bars, finished sheets, tubing, and other high quality steels.

WILLIAM K. BREEZE has been appointed Pacific Coast manager of the Jones & Laughlin Steel Corporation, Pittsburgh, Pa. Mr. Breeze will make his headquarters in Los Angeles, Calif. He was previously district sales manager in New York, and will be succeeded in that position by JOHN B. DEWOLF, who has been transferred from Philadelphia. HERBERT B. SPACKMAN will take Mr. DeWolf's place as district sales manager in Philadelphia.

ALBERT P. CRAIG, JR., has been appointed director of the World's Fair Exhibit of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Mr. Craig was assistant director of the exhibit last year and had charge of all sales of Westinghouse electrical equipment to the Fair and exhibitors. He succeeds E. H. SNIFFIN.

JOHN H. RASP has been appointed superintendent of the tool and die department of the Sintered Carbide Division of the Firth-Sterling Steel Co., McKeesport, Pa. J. H. CHIVERS has been made superintendent of melting to fill the vacancy created by the death of the late L. B. Knox.

J. M. COSGROVE has been appointed director of the Development Laboratory of the Standard Steel Spring Co., Coraopolis, Pa. Mr. Cosgrove will be engaged in research work on the new corrosion-proof coating developed by the company.

Wisconsin and Minnesota

WALTER GEIST, vice-president, DR. W. M. WHITE, manager and chief engineer of the hydraulic department, and R. C. NEWHOUSE, chief engineer of the crushing and cement division of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., have been designated by a committee of the National Association of Manufacturers as recipients of the special recognition that the Association is giving to inventors in the United States, known as the "Modern Pioneer Awards."

L. E. PHELPS has been placed in charge of the Milwaukee office of the National Tool Co., Cleveland, Ohio. Mr. Phelps was previously connected for twenty-six years with the Fellows Gear Shaper Co. of Springfield, Vt.

PAR-X PUMP CORPORATION, 400 Stinson Blvd., Minneapolis, Minn., is a new corporation formed through the merger of the CONSOLIDATED MACHINE WORKS and the HAMILTON CORPORATION.

COMING EVENTS

MARCH 6—Spring meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Hotel Statler, Detroit, Mich. C. L. Warwick, secretary, 260 S. Broad St., Philadelphia, Pa.

MARCH 6-9 — INDUSTRIAL TOOLS AND EQUIPMENT EXHIBITION at the State Armory, 1494 Main St., Bridgeport, Conn., under the auspices of the Bridgeport Tool Engineers Association.

MARCH 7-9 — Annual meeting of the AMERICAN SOCIETY OF TOOL ENGINEERS in New York City. For further information, communicate with Ford R. Lamb, executive secretary, 2567 W. Grand Blvd., Detroit, Mich.

MARCH 14-15 — Aeronautic meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Hotel Washington, Washington, D. C. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

APRIL 9-10 — MIDWEST POWER CONFERENCE at the Palmer House, Chicago, Ill., sponsored by the Armour Institute of Technology in cooperation with seven middle-western colleges and universities and various engineering societies.

APRIL 10-12—Fortieth convention of the INTERNATIONAL ACETYLENE ASSOCIATION at the Schroeder Hotel, Milwaukee, Wis. For further information, address the International Acetylene Association, 30 E. 42nd St., New York City.

APRIL 11-12—Spring meeting of the GALVANIZERS COMMITTEE at the William Penn Hotel, Pittsburgh, Pa. For further information, address the American Zinc Institute, Inc., 60 E. 42nd St., New York City.

APRIL 16-18—Eleventh annual SAFETY CONVENTION of the Greater New York Safety Council at the Hotel Pennsylvania, New York City. For further information, address Greater New York Safety Council, 60 E. 42nd Street, New York City.

MAY 1-3—National spring meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the Hotel Bancroft, Worcester, Mass. Clarence E. Davies, secretary, 29 W. 39th St., New York City.

MAY 6-7—National Production Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Bond Hotel, Hartford, Conn. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

MAY 6-8—MACHINE TOOL ELECTRIFICATION FORUM, to be held under the sponsorship of the Westinghouse Electric & Mfg. Co. at the company's plant at East Pittsburgh, Pa. For further information, address Hendley N. Blackmon, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MAY 6-10—Convention and exhibition of the AMERICAN FOUNDRYMEN'S ASSOCIATION to be held in Chicago, Ill., with exhibits at the International Amphitheater, and headquarters of the convention at the Palmer House. American Foundrymen's Association, 222 W. Adams St., Chicago, Ill.

MAY 20-22—Annual convention of the AMERICAN GEAR MANUFACTURERS' ASSOCIATION at Grove Park Inn, Asheville, N. C. J. C. McQuiston, manager-secretary, 602 Shields Bldg., Wilkinsburg, Pa.

JUNE 9-14 — Summer meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Greenbrier Hotel, White Sulphur Springs, W. Va. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

JUNE 17-20—Semi-annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the Hotel Pfister, Milwaukee, Wis. Clarence E. Davies, secretary, 29 W. 39th St., New York City.

JUNE 24-28—Annual meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at Atlantic City, N. J. C. L. Warwick, secretary-treasurer, 260 S. Broad St., Philadelphia, Pa.

OCTOBER 21-25 — NATIONAL METAL EXPOSITION, to be held at Cleveland, Ohio, under the auspices of the American Society for Metals. W. H. Eisenman, secretary, 7301 Euclid Ave., Cleveland, Ohio.

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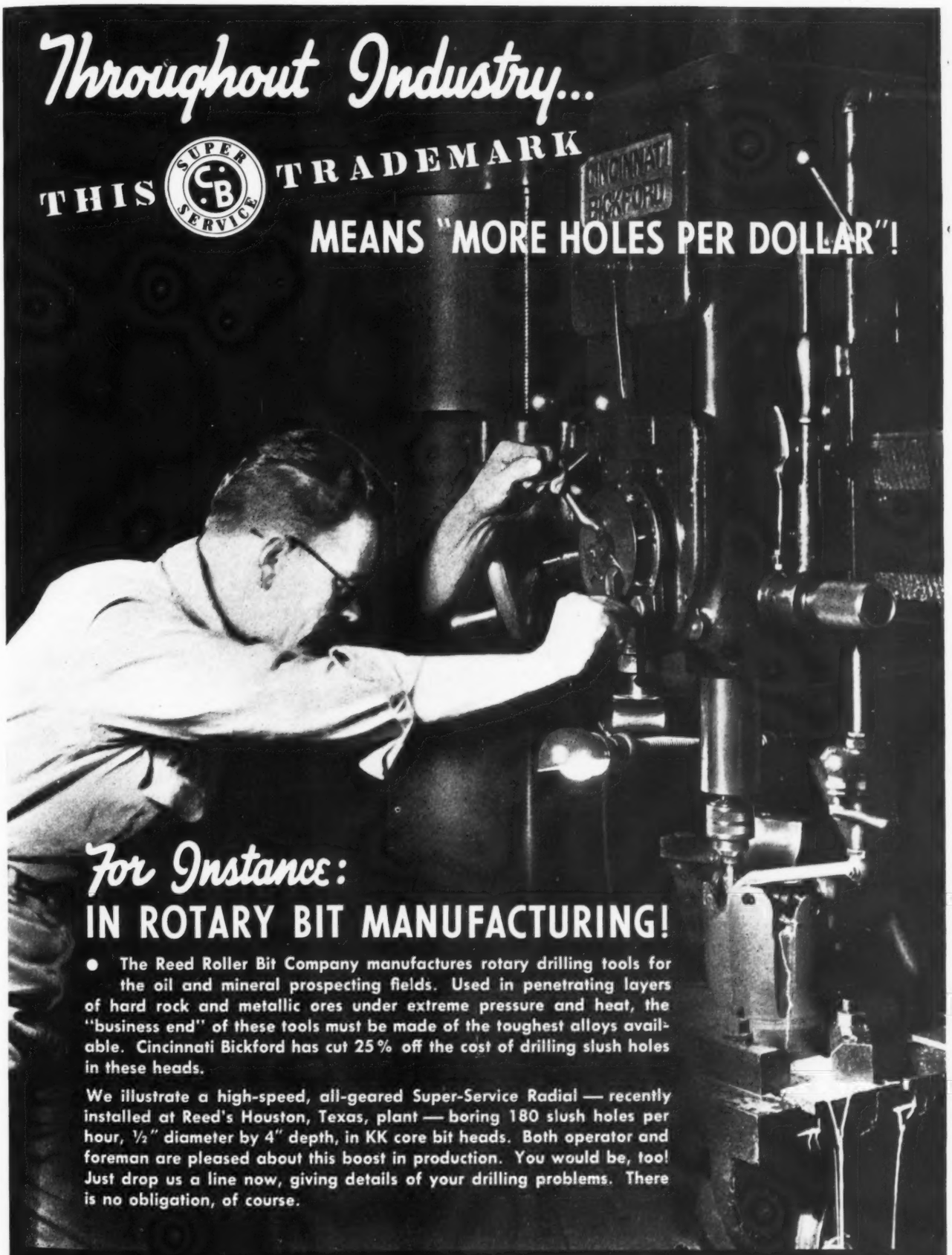

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OBITUARIES

Arthur F. Townsend

Arthur Farragut Townsend, chairman of the board of Raybestos-Manhattan, Inc., and general manager of the Manhattan Rubber Mfg. Division, Passaic, N. J., died of heart disease on January 14 at his home in Ridgewood, N. J., aged seventy-four years. Colonel Townsend was born on May 17, 1865, in Boston. After graduating from the Massachusetts Institute of Technology in 1884, he started to work as a shipping clerk with the New York Belting & Packing Co., with which company he was connected for nine years, rising to the position of assistant manager at Passaic.

In 1893, in cooperation with five other men, he organized the Manhattan Rubber Mfg. Co., serving successively as secretary, vice-president, and president. From 1903 until 1929, when Raybestos-Manhattan, Inc., was organized, he served as president of the Manhattan Rubber Mfg. Co. Since 1929, he had been chairman of the board of Raybestos-Manhattan and general manager of the Manhattan Rubber Division.

Colonel Townsend was an outstanding figure in the rubber industry. He made frequent trips to London as the American member of the Advisory Panel of the International Rubber Regulation Committee, which, since 1934, has dealt with the world's crude rubber supply. He was also president of the Manhattan Securities Co., which operates rubber plantations in Java.

Colonel Townsend took an active part in civic affairs and welfare work. He was highly respected and liked by all who knew him, especially his employes.

Donald Lamont Brown

Donald Lamont Brown, president of the United Aircraft Corporation, Hartford, Conn., died on January 29 after a long illness, at the age of forty-nine years. Mr. Brown first became associated with the aircraft industry in 1917. In 1918, he became assistant production manager of the Olds Motor Works, Lansing, Mich. In 1921, he went with the Wright Aeronautical Corporation, Paterson, N. J., as assistant factory manager. Four years later, he became one of the founders of the Pratt & Whitney Aircraft Co., Hartford, Conn., serving first as factory manager. In 1929, he was made vice-president in charge of manufacturing, and in 1930 was elected president of the company. Two years later he was made president of the United Aircraft & Transport Corporation, and in 1934, when the present United Aircraft Corporation was formed, he became president of that organization.

Mary A. Diefendorf

Mary A. Diefendorf, president and treasurer of the Diefendorf Gear Corporation, Syracuse, N. Y., died January 21 at the University Hospital in Syracuse, after an illness of two weeks.

One of the few women industrial executives in the country, Mrs. Diefendorf had been associated with the corporation since its founding by her husband, the late Willis H. Diefendorf. She had been president and treasurer of the organization since his death ten years ago.

Mrs. Diefendorf was also active in many civic and church organizations. She is survived by a son Donald W., vice-president of the company.

Max Uhlmann

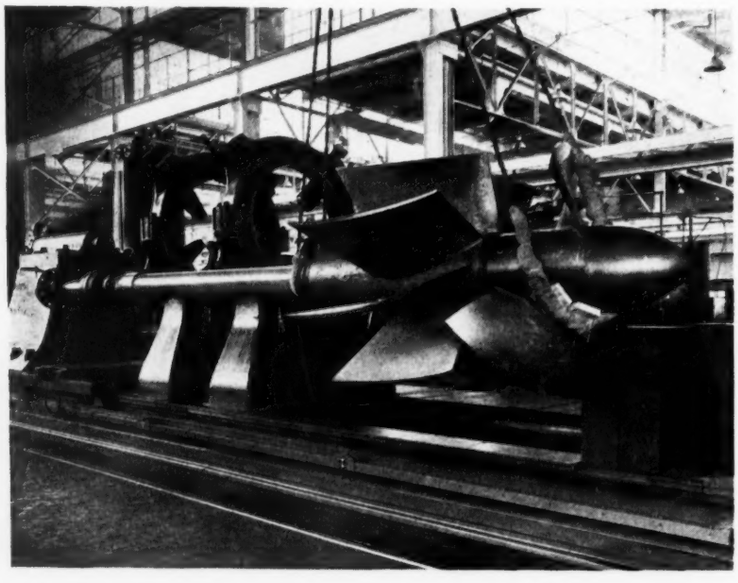
Max Uhlmann, president of the Bilgram Gear & Machine Works, Philadelphia, Pa., died of pneumonia on February 8 at the Hahnemann Hospital in Philadelphia, aged eighty-three years. Mr. Uhlmann was a native of Germany and came to the United States when he was twenty-five. He first obtained a position with the Bilgram Co. as a machinist, rising successively to the positions of superintendent, vice-president, and president. Mr. Uhlmann was known as the designer of the skew bevel-gear, and also held a number of machinery patents.

JOHN J. FASMER, until recently general sales manager of the Stephens-Adamson Mfg. Co., Aurora, Ill., died on February 3 at the age of fifty-six. Mr. Fasmer had been connected with the company since its organization in 1901, having served as superintendent of the main factory at Aurora until 1919, as manager of the St. Louis sales-engineering office until 1931, and as general sales manager at Aurora until a few months ago, when illness curtailed his activities.

JEFFERSON CARL WEISENBACH, foundry superintendent of the Cleveland Punch & Shear Works Co., Cleveland, Ohio, died at Cleveland on January 19 at the age of forty-four. He had been employed in the foundry of the Cleveland Punch & Shear Works Co. for the last sixteen years, ten years as maintenance engineer and six years as superintendent.

* * *

Employes of the General Electric Co. received close to $64,000 in 1939 for new ideas adopted under the company's suggestion system, an increase of about $12,500 over 1938. The cash awards ranged from $2 to $525. In all, 10,121 suggestions were adopted. During the last twenty years more than $1,000,000 has been paid to General Electric employes for new ideas.



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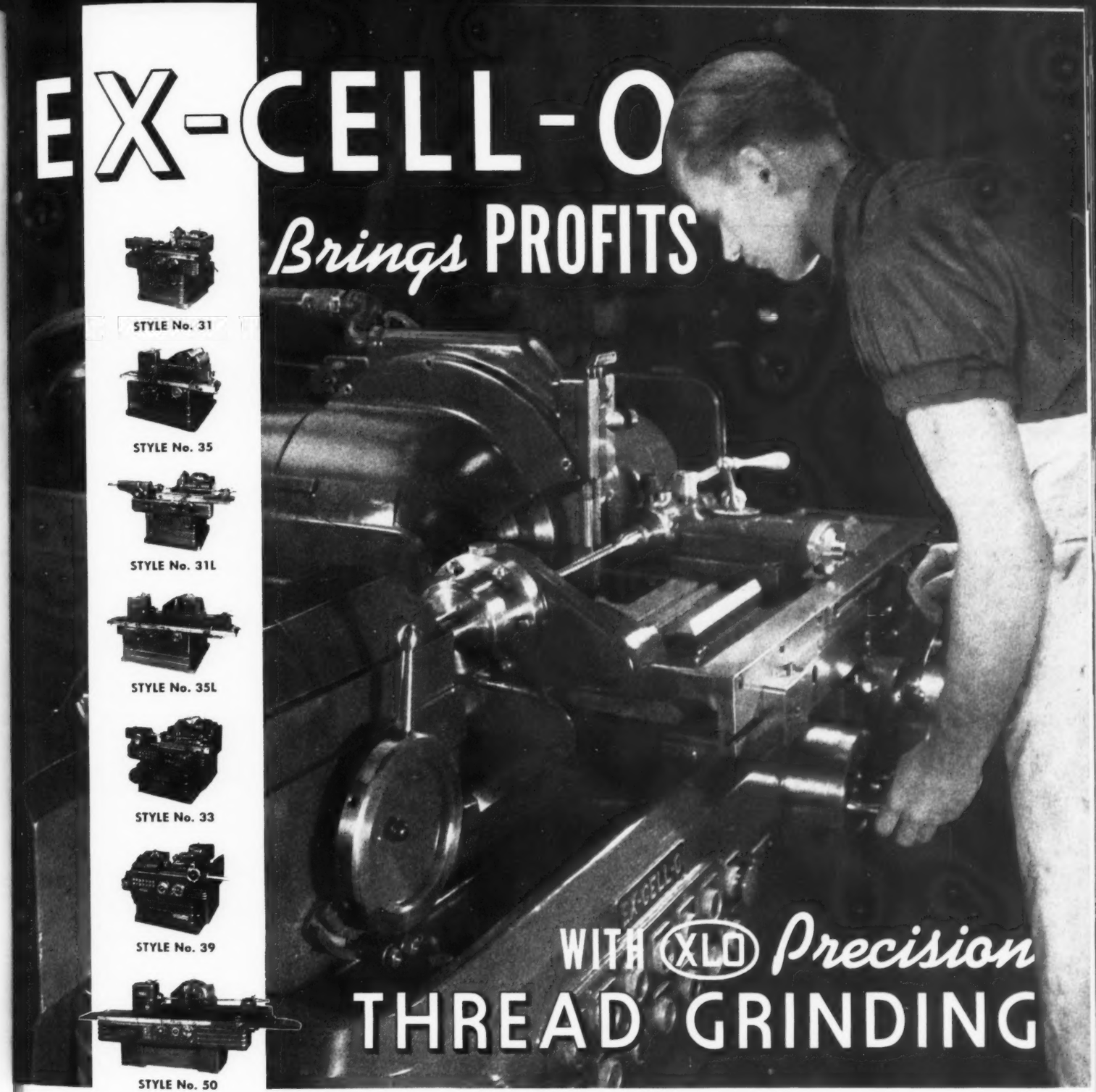

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NEW BOOKS AND PUBLICATIONS

THOMAS' REGISTER OF AMERICAN MANUFACTURERS. 4800 pages, 9 by 14 inches. Published by the M. Thomas Publishing Co., 461 Eighth Ave., New York City. Price, $15 ($10 to old subscribers).

This is the thirtieth edition of a comprehensive directory covering all the manufactured products in the United States. As in previous editions, it contains four different sections — namely, the index or finding list; the classified list of products; the alphabetical list of manufacturers, giving in many cases branch offices, subsidiaries, and officers' names; and the trade name and trademark section.

The principal section of the book, which comprises a classified list of all of the manufactured products, arranged alphabetically and geographically according to the location of the manufacturers, covers 3769 pages. There are two appendixes listing banks, chambers of commerce, and other commercial organizations, as well as leading trade papers. A valuable feature of the directory is the indication of a capital or size rating for each firm.

This book is an indispensable aid to purchasing agents in finding sources of supply, to sales departments in compiling lists of prospects, and to all other concerns who need to make lists of products or manufacturers for various purposes. It is also of value in locating the addresses of manufacturers, as well as successors of discontinued concerns. Everything possible is done to facilitate reference, including the use of different colored paper for the various sections, thorough cross-indexing, and careful sub-divisions of classifications. For a work of such colossal scope, the information is remarkably accurate and complete.

HYDRAULIC AND PNEUMATIC LEATHER PACKING—DESIGN AND APPLICATION WITH DIMENSIONAL STANDARDS. By the Engineering Department of the Chicago Belting Co. 50 pages, 8½ by 11 inches. Published by the Chicago Belting Co., Green and Washington Sts., Chicago, Ill. This book is sent free to heads of engineering departments and designing engineers only, in industrial plants using packings, either for replacement or standard equipment.

This book has been prepared because of the lack of authoritative information on the design and application of hydraulic and pneumatic leather packings. It contains a great deal of specialized engineering information based upon the long experience of the Chicago Belting Co. The purpose of the book is to give engineers of equipment manufacturers definite information that will be useful to them, especially in designing new equipment. The contents of the book are divided into a number of different sections, as follows: Why Use Leather Packings?; Metal Parts, Gland Rings, Piston Plates and Clearance; Bolts, Studs, and Piston-Rod Shoulders for Cup Packings; Leather Grip for Cup and Flange Packings; Cylinder, Plunger and Rod Surfaces Must be Smooth; Heel Corner Radius, Lip Bevel, and Flared U and Cup Packings; Springs and Expanders; Surface Speeds at Various Pressures; Temperature Limits; Choice of Packing Style — U, Flange, Cup or Vee Packings; Multiple-Vee Leather Packings; Cup Packing Specifications; Flange Packing Specifications; U-Packing Specifications; and The Advantages of Leather Packings Over Compression Packings.

THEORY AND DESIGN OF SPRINGS. By Fred M. Cousins. 99 pages, 8 1/4 by 11 inches. Published by Edwards Bros., Inc., Ann Arbor, Mich. Price, $2.50.

The study of springs has become a major problem with the introduction of high-speed engines and machinery and the development of such units as the automobile front suspension systems. Realizing the importance of this particular phase of engineering, the writer has attempted to present in this book an analysis of the more general types of springs in such a manner as to meet the requirements of both the academic student and the designing engineer. The material presented is based on the writer's experience in the automobile industry.

There are nine chapters dealing with the following subjects: Elastic Vibrations of Springs; Close-Coiled Helical Springs; Open-Coiled Helical Springs; Torsion and Spiral Springs; Conical Springs; Valve Springs; Leaf Springs and Flat Springs; Ring Springs; and Disk Springs. The book is in lithoprint form.

AMERICAN MACHINISTS' HANDBOOK. By Fred H. Colvin and Frank A. Stanley. 1366 pages, 4 by 6 1/2 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York City. Price, $4.

This is the seventh edition of a handbook for men engaged in various branches of machine shop work, including executives, toolmakers, and mechanics, as well as apprentices. It covers machine shop and drafting-room practice and includes a dictionary of shop terms. The present edition has been revised to keep pace with the constant changes in shop practice; new developments in materials, necessitating new cutting tools and methods of handling; standardization activities; etc. Much new data has been added and some material not considered vital has been eliminated to keep the size of the book at a minimum. In spite of condensation, however, it has been necessary to add over 200 pages in the new edition.

THE FABRICATION OF U.S.S. STAINLESS STEELS. 92 pages, 6 by 9 inches. Distributed by the United States Steel Corporation Subsidiaries, and obtainable through the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa., the American Steel & Wire Co., Cleveland, Ohio, the Columbia Steel Co., San Francisco, Calif., and the National Tube Co., Pittsburgh, Pa. Price, $1.

This book discusses in detail the technical and practical aspects of stainless steel fabrication. It is divided into three parts as follows: Part I deals with welding, riveting, soldering, and joint design; Part II discusses machining, cutting, forming, annealing, and pickling operations; and Part III is devoted to surface finishing and protection.

THE WELDING ENGINEER'S POCKET BOOK. 240 pages, 4 by 6¼ inches. Published by the Chemical Publishing Co., Inc., 148 Lafayette St., New York City. Price, $1.50.

This is a little handbook of pocket size, containing condensed information on welding procedure and equipment. It covers all the different welding processes, including electric arc welding, electric resistance welding, oxy-acetylene welding, and thermit welding, as well as oxygen cutting. Instructions are given for welding various kinds of metal. There is also information on the testing of welds, protection of welders, and qualifications for welding operators.

ELECTRICAL YEAR BOOK (1940). 313 pages, 4 by 6 inches. Published by Emmott & Co., Ltd., 31 King St., W., Manchester 3, England. Price, 1/6d.

The 1940 edition of this little handbook for electrical engineers has been revised and new sections dealing with electrical methods of measuring temperature and electric braking for alternating- and direct-current motors have been included. New matter has also been added on crawling and single-phasing of induction motors and on three-phase commutator motors.

PHOTOGRAPHS—THEIR USES IN INDUSTRIAL ADVERTISING AND DIRECTIONS FOR TAKING THEM. Four-page illustrated folder. Distributed by the National Industrial Advertisers Association, 100 E. Ohio St., Chicago, Ill. Price, 25 cents.